# The Engineer.

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# THE ENGINEER

## TESTING MATERIAL FOR ROLLING STOCK.

By GEORGE T. GLOVER.

THE following articles are intended to give an account of the present requirements for railway rolling stock material in this country, and the manner in which the tests are carried out. With the process of manufacture it is not proposed to deal, except where certain methods are specified, as railway engineers are more concerned with the results than the ends by which they are attained, the study of which should be left to the manufacturer. The present system of specification and inspection requires no defence at this date, it having been firmly established both by railway companies, the Admiralty, and private firms, for many years in this country, and more recently in America, where the Master Mechanics' Association has approved of it, and where some of the railroads have now testing laboratories as fully equipped as any in this country.

No attempts have up to the present been made to adopt a standard specification common to all railways, except in the case of tires, axles, and springs for private owners' wagons, introduced in 1887 by the Clearing House Committee. This class of material is under railway companies' inspection, and in the case of tires and axles, the standard specification has been adopted by several companies for their own carriage and wagon work. A point in which some improvement could be made would be the adoption of a standard length for measuring the elongation in tensile test pieces. This at present varies from 2in. to 4in. in tire, axle, &c., tests, and in plates and bars from 2in. to 10in. The length in the former case is limited owing to the curvature of the tire from which the test piece is cut, and in the case of all material it is limited by the expense of preparing a longer test piece, 4in. being perhaps the best mean for all material. A standard for bending pieces is also desirable.

Various tests are made both on articles in the complete state as delivered, and on smaller portions. Complete articles tested are tires, axles, springs, wheel centres, roof girders, piston-rods, which are tested by deflection under hydraulic or steam press, or falling weight; also chains, couplings, and wire ropes, tested by tension. Detail tests consist of:—

Tensile—Tires, axles, bars, plates, strands from ropes, castings.
Compression—Cast iron, brass, rivets, tubes.
Transverse—Cast iron, bends from axles, tires, boiler plates, steel castings, copper plates.
Expanding—Drifting tests (steel and iron) boiler tubes.
Pressure—Boiler tubes, feed and brake pipes (india-rubber).
Torsional—Wires from ropes.

It is usual for all tests of complete articles to be conducted at the makers' works, it being the most convenient method, avoiding loss of time in unnecessary carriage and in replacing articles if rejected; failure in these tests always involves rejection, no qualification being allowed by tensile test, analysis, &c.

It is customary to take 2 per cent. in most cases, or one test in every charge or blow. This is a very certain method in the case of axles, tires, &c., but it becomes more difficult to reconcile it in the case of welded work. In this case, should 2 per cent. fail, more should be taken, to the extent of 5 to 6 per cent. Should these give bad results it may reasonably be assumed that the bulk is below specified quality. No definite rules as to rejection will be laid down, this being a matter to be dealt with entirely on the merits of the case.

A few points on tensile test pieces may be noted:—(1) Test pieces, to give a comparative percentage in elongation, should be similar in form, *i.e.*, a fixed number of diameters in length. (2) The larger the diameter the greater is the elongation in equal length. (3) Should uniform proportion not be obtainable the reduction of area gives the nearest comparable measurement of toughness; the larger the reduction of area the greater appears to be the freedom from fracture by shock. (4) Elongation and reduction of area do not always agree, even in similar test pieces, owing to the fact that the pieces do not always break near the centre.

Elastic limit usually given in commercial testing is properly the yielding stress. In bending test pieces, the ratio of length to breadth and thickness should bear a definite proportion to one another. Chamfering the corners of square pieces renders the test less severe. Test pieces should not be hammered or rolled, but machined down, on account of the toughening action of work on metals.

Railway testing laboratories usually contain an ordinary Buckton single-lever testing machine, or Greenwood and Batley horizontal ditto; wire tester—tensile and torsional; oil-testing machine—frictional; and in some cases saws, lathes, &c., for preparing test pieces, but as the laboratory is usually situated at the head works of the company, it is probably more economical to draw on the shops for machines and labour. Drop testing machines, hydraulic presses, spring scragging presses, are provided at maker's works. A museum is a valuable adjunct, for containing broken specimens of ordinary material, also of materials and parts of machines, boilers, &c., which have failed or given abnormal results in practice. These latter are usually sent to the testing laboratory, and are found to have become more brittle or "fatigued" by use. This question of fatigue has been occupying the attention of scientists for a considerable period, and the writer is not therefore qualified to pronounce on it, further than to state that the brittle quality has continually come under his notice in the case of tires, axles, chains, &c., which have been in service; also that the original state can in great measure be renewed by annealing.

A chemical laboratory, whether under the chief of testing department or not, should be near to the testing laboratory, as chemical analysis is of great service to check and confirm the physical results. A good technical library should be a feature of both testing and chemical laboratories.

In the case of all steel mentioned in the following articles, unless otherwise mentioned, the acid process—Siemens and Bessemer—is used; the exceptions being in the case of a few frame and footplates for locomotives, and channels for carriage and wagon underframes.

### I.—TIRES.

Engine and tender tires are usually made from Siemens acid steel, under specifications ranging from 23 per cent. elongation in 2in., and 42 tons per sq. in. tensile strength, up to 15 per cent. in 4in., and 52 tons square inch. A few Bessemer and crucible steel tires are supplied at the upper and lower limits respectively. Some very hard tires, 10 per cent. in 2in., 56 tons per sq. in., also some oil-hardened tires are made for hot climates and sandy districts, where much wear and tear is expected.

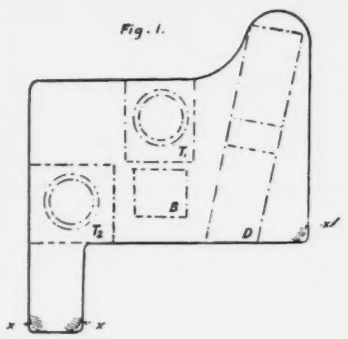
Carriage tires—Siemens or Bessemer steel—range from 25 per cent. in 3in., and 35 tons per sq. in., up to 15 per cent. in 4in., and 42 tons to 45 tons per sq. in.; wagon tires—Bessemer or Siemens steel, at equal cost—from 25 per cent. in 3in., and 35 tons per sq. in.; private owner's specification, up to 20 per cent. in 4in., and 38 to 42 tons per sq. in. The hardness, and consequently the wearing power of carriage and wagon tires, is limited in certain sections—Fig. 4—where the rim R has to be sufficiently ductile to hammer down when cold, without cracking, on to a bevelled retaining ring. Some carriage and wagon tires for abroad—India, the Colonies, &c.—are made of equal hardness with engine tires, the extra first cost being more than covered by longer mileage obtained, steel scrap tires being of no use out there, and not worth the expense of shipping home.

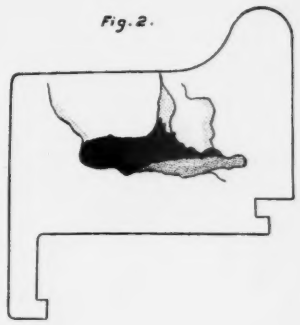
Bending tests, 1in. square bar, to bend 90 deg.; also drifting tests, $\frac{3}{4}$in. hole to expand to $1\frac{1}{2}$in. diameter, are sometimes required. It is customary to subject one tire in each charge, or 2 per cent.—where the furnace is too small to melt for fifty tires at once—to compression under a hydraulic press or falling weight, the amount of deflection varying with the class and diameter of tire; thus for small engine tires under 3ft. diameter, a deflection of $\frac{1}{8}$in. inside diameter—$1\frac{1}{2}$in. per foot—is required; for larger sizes of engine, also carriage and wagon tires, various specifications ask for $\frac{1}{4}$in. external diameter up to $\frac{1}{4}$in. internal diameter—2in. per foot. Private owner's specification requires 4in. total deflection on 2ft. 9in. internal diameter.

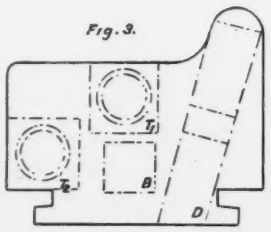
The compression test under falling weight is slightly more severe than with the press, owing to the sudden shock with which the deflection takes place. In the case of "deep-lipped" engine tires, Figs. 1 and 2, a slight fillet, $x\,x\,x$, may be turned off before testing, to avoid sharp angles, and sometimes the lips are specified to be turned off, but this hardly gives a test of the tire in a working condition.

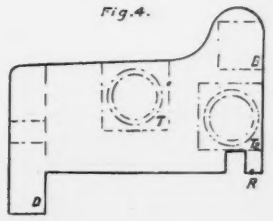
For test, cold tires are selected from bulk, or wasters may be taken if offered by the makers, and are tested with results as shown in the first section of Table I.; after giving the required deflection, they are nicked, broken, the fracture examined, and a piece about a foot long selected for tensile purposes. The makers sometimes prefer the tensile piece to be taken from the least strained portion—C D, Fig. 5—but experience has shown that the piece from which the test piece is taken is, for all practical purposes, immaterial. The piece of tire is then sawn into slabs, as in Figs. 1, 3, 4, from which two tensiles, $T_1$ and $T_2$, one bending piece, B, and one drifting test, D, are obtained. These sketches show that such small standard lengths for elongation as 2in. and 4in. are taken, on account of the curvature of the broken tire piece.

Table I. shows the influence of the diameter on the stiffness of the tire. The two engine tires are of precisely




TIRE TESTS

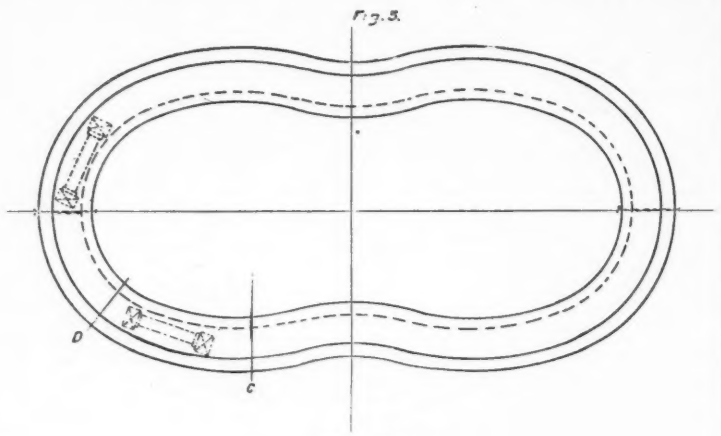
TABLE I.—*Average Tests. Various Classes of Tires.*

| Description. | Material. | Dia. | Analysis. | | | | | Tensile. | | | Falling weight test. | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | | | C. | P. | S. | Si. | Mn. | Elong. p.c. in 4in. | Red. | Ult. stress. | 10ft. | 15ft. | 20ft. | 25ft. | 30ft. | 30ft. | 30ft. | 30ft. | 30ft. | 30ft. |
| | | ft. in. | | | | | | | | | in. | in. | in. | in. | in. | in. | in. | in. | in. | in. |
| Engine ... | Siemens .. | 5 1 | ·62 | ·04 | ·02 | ·28 | ·55 | 16 | 25 | 50·1 | $\frac{3}{4}$ | $2\frac{1}{4}$ | $3\frac{3}{8}$ | $5\frac{1}{8}$ | $6\frac{1}{2}$ | 8 | $9\frac{3}{8}$ | $10\frac{5}{8}$ | $11\frac{3}{4}$ | 13 |
| Engine ... | Siemens ... | 3 0 | ·50 | ·06 | ·02 | ·10 | ·91 | 16 | 24 | 43·2 | $\frac{1}{8}$ | $\frac{1}{2}$ | $1\frac{1}{4}$ | $2\frac{1}{8}$ | $3\frac{3}{16}$ | $4\frac{9}{16}$ | $5\frac{1}{4}$ | $6\frac{7}{8}$ | $7\frac{7}{8}$ | — |
| Carriage ... | Siemens ... | 3 0 | ·46 | ·04 | ·05 | ·16 | ·76 | 19 | 20 | 40·7 | $\frac{1}{2}$ | $1\frac{3}{8}$ | $2\frac{3}{4}$ | $4\frac{1}{4}$ | $5\frac{5}{8}$ | 7 | — | — | — | — |
| Wagon ... | Siemens .. | 2 8 | ·38 | ·04 | ·05 | ·19 | 1·20 | 19 | 36 | 39·6 | $1\frac{1}{4}$ | $3\frac{1}{8}$ | $4\frac{5}{8}$ | $5\frac{3}{4}$ | 7 | — | — | — | — | — |
| Wagon ... | Siemens ... | 2 8 | ·37 | — | — | — | — | 21 | 38 | 42·8 | Compressed ; 8in. deflection. | | | | | | | | | |
| Wagon ... | Bessemer ... | 2 8 | ·34 | — | — | — | — | 17 | 24 | 39·5 | $1\frac{1}{2}$ | $3\frac{1}{4}$ | $5\frac{1}{4}$ | $7\frac{1}{2}$ | — | — | — | — | — | — |
| Wagon ... | Bessemer ... | 2 8 | ·33 | ·04 | ·07 | ·08 | 1·31 | 22 | 45 | 40·4 | Compressed ; 8in. deflection. | | | | | | | | | |
| | | | | | | | | | | | Bend. | | Drift. | | | | | | | |
| Engine ... | Siemens ... | — | ·52 | ·05 | ·03 | ·18 | ·81 | 15 | 23 | 46·6 | 53 deg. broke. | | $1\frac{1}{16}$in. cracked. | | Photo I. | | | | | |
| Wagon .. | Bessemer .. | — | ·31 | ·03 | ·04 | ·09 | 1·23 | 21 | 32 | 41·8 | 180 deg. broke. | | $1\frac{1}{16}$in. good. | | Photo II. | | | | | |

the same section, Fig. 1, the smaller tire being nearly twice as stiff as the other, while the thin carriage tire, of softer material, has only given a deflection equal to the much heavier and stronger section tire of larger diameter.

Should the first tire taken fail to stand the compression test, two more may be selected from the same batch, and should these fail, the lot represented is either rejected or annealed, if thought desirable. Tires often fail owing to high tensile strength induced by chilling—shown by finer crystalline margin on the fractured tire—either by the water jet whilst being rolled, or unequal cooling subsequently. This hardness may be reduced by annealing—see Table II. In this case the tires stand the test when again tried. Should they not do so, this shows conclusively that the composition of the material is at fault, except in the rare instances where they have been annealed at too high a temperature.

Fig. 5.




TIRE TEST

Table II.—*Effect of Annealing on Wagon Tires.*

| Material. | Carbon. | Unannealed. Elong. per cent. in 4in. | Unannealed. Red. area. | Unannealed. Ult. stress. | Annealed. Elong. per cent. in 4in. | Annealed. Red. area. | Annealed. Ult. stress. |
|---|---|---|---|---|---|---|---|
| Bessemer... | — | 13 | 18 | 48·7 | 25 | 50 | 41·9 |
| Bessemer... | — | 12 | 14 | 43·9 | 23 | 56 | 40·3 |
| Siemens ... | ·38 | 18 | 31 | 38·6 | 28 | 42 | 35·7 |
| Siemens ... | — | 8 | 11 | 42·3 | 21 | 47 | 31·6 |

*Effect of Chilling* (*Test Piece Chilled after Cutting.*)

| | | Normal. Elong. | Normal. Red. area. | Normal. Ult. stress. | Chilled. Elong. | Chilled. Red. area. | Chilled. Ult. stress. |
|---|---|---|---|---|---|---|---|
| Siemens ... | — | 25 | 47 | 38·6 | — | nil | 65·7 |

*Effect of Oil Hardening* (*Whole Tire Treated*).

| | | As rolled. Elong. | As rolled. Red. area. | As rolled. Ult. stress. | Oil hardened. Elong. | Oil hardened. Red. area. | Oil hardened. Ult. stress. |
|---|---|---|---|---|---|---|---|
| Siemens ... | — | 19 | 29 | 36·4 | 23 | 35 | 38·9 |

The effects of annealing on the tensile test is to cause a reduction in the ultimate stress, and an increase in the elongation and reduction of area. A reduction of 4 tons in ultimate stress is normal, those in the subjoined table, showing a fall of 7 to 10½ tons, must have been in a state of high initial stress due to chilling, and therefore unfit for use. In Photo. III. are shown three tests, which clearly show the effect of chilling. In this case the piece cut from the tire was chilled subsequently, and therefore shows a more exaggerated state of hardness than would occur in a tire.

Tire steel, especially when of high tensile stress, may be much improved by a process of oil-hardening, the tire, after rolling, being heated to dull cherry red and cooled out in oil. This hardens it to a certain extent, but the ductility is restored by again heating it to redness and allowing it to cool slowly in ashes. The advantage lies in the fact that the ductility and the tensile stress may be increased at the same time, and very hard tires endered capable of standing the drop test.

Table III. shows a number of results of test of tires which either failed under test or which were rejected owing to bad composition. The carbon and tensile test in the first two cases were too high to allow of the tires deflecting the specified amount, 7in. and 5½in. respectively. The last three tires were not made in this country, and the last tire contains quite an abnormal proportion of sulphur. The test aimed for in these three cases was 25 per cent. in 3in. elongation, with 35 tons square inch ultimate stress.

It is usual to specify for all classes of tires that sulphur and phosphorus should not exceed ·05 per cent.; the manganese should range from 0·65 to 0·9 per cent. for high carbon, and 1·0 to 1·25 for Bessemer tires. C. varies with tensile test required, but should not differ, in various tires of same charge, by more than ·05 per cent., by colour test, as this indicates bad mixing of metal, among other things. High silicon is allowable where Swedish iron is used in the mixture, as S. and P., which are most detrimental, are only present in such steel in small quantities—·02 to ·03 per cent. The only test that the writer knows of for the detection of class of pig used is analysis of steel for arsenic; no trace should be found where Swedish is principally used, as this iron is exceptionally free from it. As. is always present where ordinary pig is used.

Table III.—*Tires Failing in Test or Rejected for Bad Composition.*

| Material. | | Dia. | Analysis. C. | P. | S. | Si. | Mn. | Tensile. Elong. p.c. in 4in. | Red. | Ult. stress. | Compression tests. 10ft. | 15ft. | 20ft. | 25ft. | 30ft. | 30ft. | 30ft. | 30ft. |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | | ft. in. | | | | | | | | | in. | in. | in. | in. | in. | in. | in. | in. |
| Engine... ... | Siemens ... | 3 6 | ·74 | ·04 | ·02 | ·09 | ·72 | 8 | 8 | 58·1 | ¼ | $\frac{9}{16}$ | $\frac{13}{16}$ | $1\frac{9}{16}$ | $2\frac{1}{16}$ | $2\frac{1}{2}$ | $2\frac{13}{16}$ | $3\frac{3}{32}$ b'ke |
| Wagon .. ... | Bessemer ... | 2 8 | ·51 | ·04 | ·03 | ·09 | 1·44 | 3 | 5 | 52·2 | Failed at 4in. deflection instead of 5½in. | | | | | | | |
| Wagon... ... | Bessemer ... | 2 8 | ·37 | ·06 | ·06 | ·06 | ·77 | 16 | 29 | 42·5 | | | | | | | | |
| Wagon... ... | Bessemer ... | 2 8 | ·44 | ·05 | ·03 | ·43 | ·91 | 18 | 21 | 45·7 | Stood 4in. specified deflection. | | | | | | | |
| Wagon... ... | Bessemer ... | 2 8 | ·31 | ·07 | ·18 | ·25 | ·72 | 27 | 43 | 37·0 | | | | | | | | |

Table IV.—*Test from Worn Engine Tires.*

| | Analysis. C. | P. | S. | Si. | Mn. | Tensile tests. Elong. 4in. | Red. area. | Ult. stress. | Mileage. | |
|---|---|---|---|---|---|---|---|---|---|---|
| Engine, 7ft. driving ... ... | ·52 | ·04 | ·05 | ·10 | ·68 | 20 | 29 | 40·70 | 423,319 | Worn thin |
| Engine, 5ft. 6in. leading ... | ·58 | ·06 | ·03 | ·32 | ·56 | 15 | 18 | 48·06 | 177,057 | — |
| Engine, 5ft. leading ... ... | ·58 | ·06 | ·02 | ·22 | ·59 | 16 | 21 | 44·28 | 2,310 | "Piped." Fig. 2. |
| Engine, 3ft. 6in. bogie ... ... | ·56 | ·07 | ·04 | ·31 | ·56 | 17 | 25 | 45·00 | 28,707 | — |

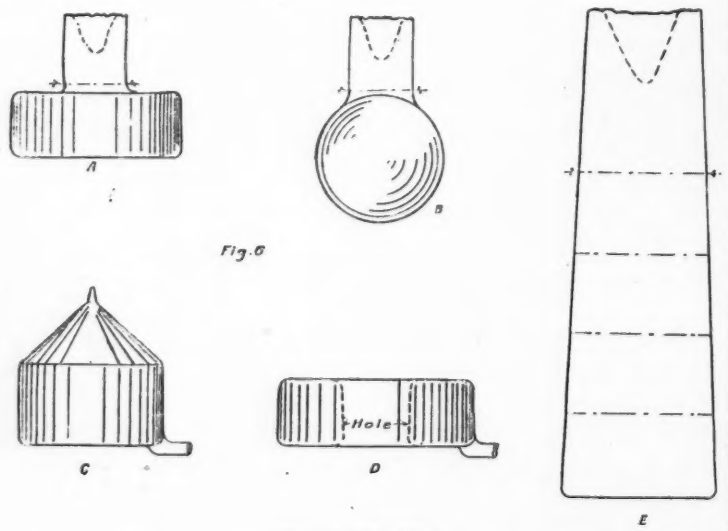
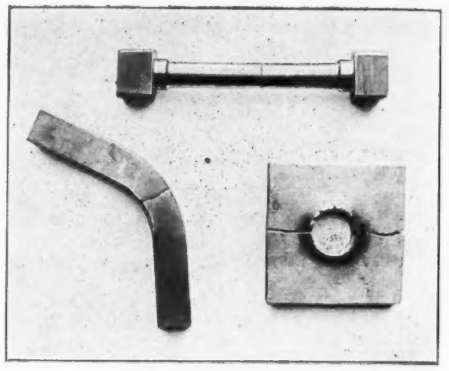



Fig. 6

FORMS OF INGOTS

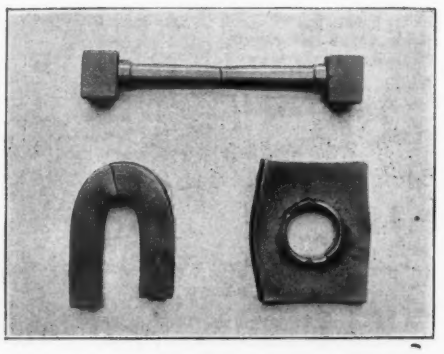
An old-fashioned test, not now much in use, consists in dropping steel tires on to a heavy block from a height varying inversely as the diameter. In the case of high carbon tires this is justifiable—one large steel works does so on its own account—but tires which have passed this test are not prevented from breaking under the more severe test of shrinking on to the wheel centres. Tires which have been shrunk on and removed again will not stand this test without failure.

Tires are sometimes gauged for diameter and section by inspectors, and also weighed; but all these points are usually attended to by the makers, as tires found unsatisfactory on receipt are replaced at their expense. The turning allowance is about $\frac{3}{16}$in. on diameter for engine and ¼in. for carriage and wagon tires.



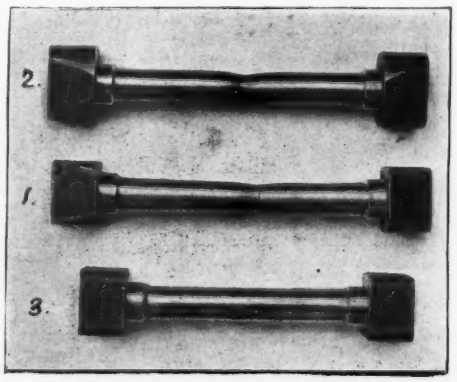
Photograph I.—Engine Tire—Siemens Steel.
Analysis—C. ·52, P. ·05, S. ·03, Si. ·18, Mn. ·81
Tensile—Elong. 15 per cent. in 4in., 23 per cent. Red., 46·6 tons sq. inch.
Bend, 53 deg. broke. Drift, 1¼in. cracked.

As the type of ingot to be used is sometimes specified, these may here be mentioned. For engine tires it is usual to take an ordinary rectangular ingot—Fig. 6B—of required temper, remove the top third, and cut the remainder into suitable sizes for tire blooms. At least a third of the top of the ingot should be removed, as this contains the "pipe," also the segregation of impurities, and too much silicon and floating slag; should this not be done, piped tires occasionally occur—as Figs. 2—which broke after running 2000 miles.



Photograph II.—Wagon Tire—Bessemer Steel.
Analysis—C. 31, P. ·03, S. ·04, Si. ·09, Mn. 1·23
Tensile—Elong. 21 per cent. in 4in., 32 per cent. Red., 41·8 tons sq. inch
Bend, 180 deg. broke. Drift, 1¼in. good

For carriage and wagon work the ingots take various shapes, Fig. 6, C. Form C is very suitable; it is poured from below, a large proportion of dirt is left in the "well," or "runner," and any dirt in the ingot rises to the top of the cone, being afterwards removed during the punching process. Forms A and B are poured from the top, but have a head large enough to contain all dirt, &c., which is cut off prior to flattening. Form D, even when poured from below, is most likely to leave slag, &c., in the finished tire. These ingots are flattened, a piece punched out, being weighed both before and after this, in order to roll the tire to right diameter at required




Photograph III.—Wagon Tire—Siemens Steel.
Tests showing the effects of annealing and hardening.
Analysis—C., P., S., Si., Mn.

| Condition. | Elong. p.c. in 4in. | Red. area, per cent. | Tons sq. in. |
|---|---|---|---|
| 1. Tire as tested by compression.. | 25 | 47 | 38·6 |
| 2. Annealed.. .. .. .. .. .. | 26 | 51 | 38·0 |
| 3. Heated to cherry red and cooled in water 60 deg. .. .. .. | — | Nil | 65·7 |

section; the bloom is "beaked" on an anvil under a steam hammer, reheated, and rolled to finished size. "Wasters" consist of tires rolled too large, or too small in diameter, failures to come up to full section, sand cracks, steel parings rolled in, overlaps due to blowholes and burnt tires. Any tires not perfectly round may be reheated and "blocked."

Old tires do not appear to show any deterioration in tensile test, although undoubtedly more brittle—see Table IV.—the first tire in this list being made to a specification for lower tensile strength than the others, the third being the case of "piping" mentioned above.

TABLE V.—*Engine Tires.*

| | C. | P. | S. | Si. | Mn. | Elong. per cent. | Elas. lim. | Ult. stress. |
|---|---|---|---|---|---|---|---|---|
| Siemens ... | 59 | ·03 | ·02 | ·29 | ·645 | 16 | 26·4 | 45·8 |
| Siemens ... | 51 | ·024 | ·022 | ·296 | ·945 | 13·5 | 28·6 | 46·7 |
| Siemens ... | 57 | ·03 | ·034 | ·10 | ·74 | 15·5 | 31·2 | 45·5 |

TABLE VI.—*Wagon Tires.*

| | C. | P. | S. | Si. | Mn. | Elong. per cent. | Elas. lim. | Ult. stress. |
|---|---|---|---|---|---|---|---|---|
| Bessemer... | ·31 | ·04 | ·05 | ·09 | 1·13 | 20 | 24·1 | 38·4 |
| Bessemer... | ·28 | ·04 | ·04 | ·08 | 1·40 | 23 | 24·9 | 39·2 |
| Bessemer... | ·33 | ·04 | ·04 | ·12 | 1·28 | 19 | 27·0 | 40·8 |
| Bessemer... | ·37 | ·03 | ·04 | ·09 | 1·00 | 21 | 28·4 | 40·3 |
| Bessemer... | ·31 | ·04 | ·03 | ·12 | 1·07 | 19 | 25·6 | 39·8 |
| Siemens ... | ·37 | ·04 | ·05 | ·10 | 1·22 | 21 | 23·9 | 38·9 |
| Bessemer... | ·31 | ·03 | ·03 | ·09 | 1·08 | 18 | 25·3 | 39·3 |

Tables V. and VI. are averages from a very large number of tires by various makers, and tend to show that specifications for ingredients should not be too hard-and-fast, as all the above tires passed any test required of them, although C. varied as much as ·09 per cent. in the case of the wagon tires.

*(To be continued.)*

## THE NEW NORTH BRITISH EXPRESS ENGINE.

By CHARLES ROUS-MARTEN.

ONLY a few years ago the North British Railway was a byeword for slowness and general torpor. It possessed fine express engines, but made no adequate use of them. Up to a comparatively recent period there was not a single decent express to be found on its entire system.

But *tempora mutantur*. Under the enlightened and vigorous rule of Mr. Conacher and Mr. Deuchars the North British line has come to be justly regarded as among the smartest and most progressive railways in the kingdom. Even the long-existent nightmare-horror of Waverley Station is rapidly becoming an evil memory of the past, and soon the magnificent new station which is steadily growing over the unvenerable ruins of the old atrocity will be the admiration of every visitor to Edinburgh.

Nor will the locomotive department be found lagging behind in the general advance. For many years the North British Railway has possessed some remarkably fine and efficient engines. Those originally designed by Mr. D. Drummond proved so useful and satisfactory that on his migration to the Caledonian his successor, Mr. Matthew Holmes, the present very able locomotive superintendent of the North British line, wisely adhered to the general type, while introducing from time to time such improvements as experience suggested, until, by degrees, he developed the notable engine about which I have a good deal to say to-day.

Mr. Holmes began with a class which, outwardly resembling Mr. Drummond's "476" class, and having, like the locomotives of that class, 6ft. 6in. coupled wheels and 26in. piston stroke, had an inch less of cylinder diameter. These, numbered 574—579 inclusive, have always been employed on the Edinburgh-Glasgow service, occasionally piloting to Perth. They have proved useful engines, but their class has not been perpetuated, and their number still remains only six. Next, Mr. Holmes introduced the "592" class, in which he added an inch to the diameter of the cylinders and 6in. to that of the coupled wheels. Twelve of these, Nos. 592—603, were built. They are remarkably fine engines, and have always done excellent work. Greater tractive force was, however, deemed necessary to grapple with the increasing weight of the expresses, and so Mr. Holmes reverted to 6ft. 6in. wheels, retaining the 18 by 26 cylinders, and providing additional boiler power and steam pressure. Of this class a large number have been constructed during the past ten years, and for a long time it seemed as if they were to constitute the permanent standard type for the North British line.

In the famous race to Aberdeen of 1895 these locomotives acquitted themselves with much credit under distinctly difficult conditions. The excellent work of Nos. 211, 212, 262, 293, and others in that memorable time excited warm admiration and is not yet forgotten. Again, when, in the year 1897, that notable "match against time" was begun by the North British in undertaking to keep time in all circumstances between Berwick and Edinburgh, notwithstanding the disadvantage of an extra stop and a change of engines, as compared with the duty performed by the North-Eastern while working that service, Mr. Holmes' engines performed their part not merely efficiently, but brilliantly, doing on nearly every occasion even more than had been undertaken, and often making up on the very fast-timed run from Berwick to Edinburgh time which had been lost on the earlier length from London. I described at the time in the columns of THE ENGINEER many of these remarkable feats.

Nor was it merely a temporary "spurt," for the work was done continuously for considerably over a year, and only ceased on a decision being given conferring on the North-Eastern the right of "horsing" some of the through trains on the North British road. Engines Nos. 598, 603, 634, 639, 640, 641, and 642 gave me the best results in my own experience, but I believe that others did almost equally well. A run of 62½ min. from Edinburgh to Berwick with the corridor "diner," weighing 220 tons, was the most meritorious of all, taking speed, weight, and hill-climbing into account; but, with two engines on, the run was made in 57 min., and even less.

Still loads continued steadily to grow, and piloting was necessitated, while a further augmentation of weight was certain as soon as this year's tourist season should set in. So as more engines were needed, it was decided to take a fresh departure in respect of enhanced power.

The result has been the production of the new "729" class, designed by Mr. Holmes, and built in the company's locomotive works at Cowlairs, near Glasgow. In these engines the 6ft. 6in. coupled wheels and 26in. piston stroke of the older engines are retained, but the cylinder diameter is increased from 18in. to 18½in., the tractive force being thus enlarged from 108 lb. to 111 lb. for every pound of effective steam pressure in the cylinders. The steam pressure in the boiler is increased from 150 lb. to 175 lb. per square inch, and the total heating surface from 1262 to 1350 square feet, of which 1224ft. is in the tubes—254 in number, 1⅞in. in diameter—and 126 square feet in the fire-box, while the fire-grate has an area of 20 square feet. The engine has a leading bogie, with 3ft. 6in. wheels, steam sanders, train-heating apparatus, and Westinghouse brake. Already six of these fine engines have been built, and six more are in course of construction for the coming tourist season. They are stationed at Edinburgh and Perth.

So far their principal duty has been to run the heavy London expresses, notably the corridor dining trains between Berwick and Edinburgh. This duty they perform to admiration, keeping time with the utmost ease, without the aid of pilots. Through the courtesy of Mr. Conacher, general manager; Mr. Deuchars, superintendent of the line; and Mr. Holmes, locomotive superintendent, I have been able to make some very interesting tests of the actual working of the new locomotives. The results were curiously uniform, and, I may add, uniformly satisfactory. I will give two instances in illustration. In each case the train tested was the 2.20 p.m. corridor dining train from Edinburgh to Berwick, the loads being identical, viz., 227 tons empty, but amounting, with passengers, luggage, and stores included, to over 240 tons, while in each case there was a fresh cross wind blowing. I may add that no special preparations were made in the way of providing picked coal, &c., even the dates not being fixed beforehand or the driver warned in advance, the object being to test what the engine could do under normal conditions of working, although, of course, when the actual time arrived the driver was made aware that he was to do his best, and might run somewhat in advance of booked time in order to see what could be done in the way of acceleration should this be deemed advisable at a later period. The engine employed was No. 729, the pioneer of the series.

In THE ENGINEER of March 12th, 1897, page 257, I gave a gradient section of the Edinburgh-Berwick length of the North British line. To sum up briefly, the gradients may be stated as beginning with a sharp drop at 1 in 78 for half a mile, then undulating in short rises and falls, mostly at 1 in 300, to Dunbar, 29¼ miles, next ascending first at 1 in 200, and then—for nearly five miles—at 1 in 96 to the fortieth mile-post, 1¼ miles short of Grant's House; finally descending at 1 in 200 and 1 in 190—with a midway break of about two miles up and two miles level—for 16¼ miles to Berwick.

Starting two minutes late, in the earlier instance, the engine, after attaining full speed, maintained a very even rate of running, hardly any difference being caused by the alternation of slight ups and downs. Thus the distance of 26¼ miles from Portobello to Dunbar was done in 25 min. 52 sec., and the 16 miles from Longniddry to Dunbar in 14 min. 51 sec. The speed was well maintained until the steep rise at 1 in 96 was encountered, and then it gradually fell until a minimum of 33 miles an hour was reached, which was kept up steadily to the summit. This is very good work with so heavy a load on such a grade and without pilot assistance. Other engines have often dropped to 27 miles an hour up that bank with a load of less than 200 tons. The subsequent descent to Berwick was smartly performed, but without any exceptional maximum speed being attained. The train was considerably before time, and it was very doubtful whether a clear run in would be secured. This doubt soon became a negative certainty. After running 12 miles in 10 min. 44 sec., a sharp check was encountered at the Marshal Meadows box, 56 miles from Edinburgh, where speed was reduced to 25 miles an hour, the box being passed in exactly 60 minutes from the start. Getting the road clear again, a quick run into Berwick and a very sharp pull up, brought the journey of 57½ miles to a close in 62 min. 1 sec. The time lost by the check was exactly 41 secs., and about the same by a slight delay just after starting. Practically, therefore, the net time may be regarded as 60½ minutes.

On the second occasion the start was made with absolute punctuality. After a somewhat cautious beginning, the engine and its driver rapidly warmed up to their work, and, as will be seen by the "logs" annexed, the figures of the previous trip were speedily overhauled and passed. Dunbar was breasted in quicker time than on the former occasion, but the ascent of the Cockburnspath bank was slightly slower, 2 sec. more being occupied between Dunbar and Grant's House, while the minimum speed up the five miles of 1 in 96 was 32 miles an hour. It should be noted that the speed did not fall below 59 miles an hour up a short length of 1 in 200. The summit—40 miles—once passed, the engine soon recovered velocity, and at the 46th mile had attained 70 miles an hour down 1 in 200, and this rate was well sustained, with a slight loss near the fiftieth post, where the grade temporarily rises, but with an improvement subsequently to 72 miles an hour. This would have been further bettered, but unfortunately, when the fifty-fifth mile-post had been passed in 57 min. 42 sec., a distant signal standing at "danger" came into sight, and a prompt slackening was followed by almost a dead stop at the fatal Marshal Meadows box, which had spoiled the preceding run. "Road clear" being at length given, we completed our journey to Berwick without an absolute halt, making the run of 57½ miles in 61 min. 40 sec. from start to stop, of which fifty-seven miles were done in 60 min. 23 sec. The exact loss by the Marshal Meadows check was 1 min. 13 sec., so that the net run was virtually made in the even hour. This, I need hardly say, is excellent work when the nature of the road, the weight of the train, and the strength of the wind are taken into due consideration. I append a detailed account of the running mile by mile.

| Miles. | June 20th. min. sec. | Miles. | June 23rd. min. sec. |
|---|---|---|---|
| 0 | 0 0 | 0 | 0 0 |
| 5 | 7 8 | 5 | 7 20 |
| 10 | 12 32 | 10 | 12 26 |
| 11 | 13 35 | 11 | 13 25 |
| 12 | 14 35 | 12 | 14 22 |
| 13 | 15 33 | 13 | 15 18 |
| 14 | 16 32 | 14 | 16 13 |
| 15 | 17 31 | 15 | 17 7 |
| 16 | 18 28 | 16 | 18 3 |
| 17 | 19 24 | 17 | 18 56 |
| 18 | 20 19 | 18 | 19 48 |
| 19 | 21 11 | 19 | 20 39 |
| 20 | 22 5 | 20 | 21 29 |
| 21 | 23 0 | 21 | 22 22 |
| 22 | 23 56 | 22 | 23 15 |
| 23 | 24 56 | 23 | 24 11 |
| 24 | 25 56 | 24 | 25 8 |
| 25 | 26 53 | 25 | 26 3 |
| 26 | 27 48 | 26 | 26 57 |
| 27 | 28 44 | 27 | 27 51 |
| 28 | 29 36 | 28 | 28 43 |
| 29 | 30 30 | 29 | 29 35 |
| 30 | 31 25 | 30 | 30 31 |
| 31 | 32 27 | 31 | 31 31 |
| 32 | 33 30 | 32 | 32 32 |
| 33 | 34 31 | 33 | 33 33 |
| 34 | 35 31 | 34 | 34 33 |
| 35 | 36 31 | 35 | 35 33 |
| 36 | 37 39 | 36 | 36 39 |
| 37 | 38 58 | 37 | 37 52 |
| 38 | 40 33 | 38 | 39 31 |
| 39 | 42 18 | 39 | 41 17 |
| 40 | 44 12 | 40 | 43 10 |
| 41 | 45 49 | 41 | 44 47 |
| 42 | 47 4 | 42 | 46 1 |
| 43 | 48 7 | 43 | 47 2 |
| 44 | 49 5 | 44 | 48 2 |
| 45 | 50 0 | 45 | 48 56 |
| 46 | 50 53 | 46 | 49 49 |
| 47 | 51 46 | 47 | 50 40 |
| 48 | 52 37 | 48 | 51 32 |
| 49 | 53 27 | 49 | 52 23 |
| 50 | 54 22 | 50 | 53 16 |
| 51 | 55 17 | 51 | 54 11 |
| 52 | 56 12 | 52 | 55 6 |
| 53 | 57 7 | 53 | 55 56 |
| 54 | 58 1 | 54 | 56 46 |
| 55 | 58 51 | 55 | 57 42 |
| 56 | 60 8 | 56 | 59 1 |
| 57 | 61 8 | 57 | 60 23 |
| 57½ | 62 1 | 57½ | 61 40 |

In these tables I have ignored fractions of seconds, as the speed was not so high as to render it necessary to take into account such minute periods of time.

## THE PARIS EXHIBITION OF 1900.

JUDGING from the energy and expedition with which our French neighbours are pushing on the execution of the numerous and various works destined to serve and adorn their great coming Exhibition, they appear to be fully aware that they have no time to spare. In that opinion we cordially concur, although it must be admitted that some of the more important examples of construction are fairly well advanced. At the same time other buildings of a similar character are by no means in so forward and favourable a stage. It will therefore, we think, be of interest to our readers if we place before them a brief record of the state of the works alluded to up to date. There is no doubt that, from an engineering point of view, the most prominent structure is the "Pont Alexandre III.," the first stone of which bridge was laid by the Czar of all the Russias some three years ago with considerable pomp and ceremony. It is unquestionably a very handsome bridge, and on a future occasion it will be illustrated, and described more in detail in our columns. A short time ago the Prince of Wales, who accepted the post of Commissioner-General of the British section, visited the site, inspected the foundations, and expressed his satisfaction with the progress made. This royal bridge, as it may be fairly termed, is carried over the Seine in line with the axis of the splendid avenue Nicholas II., which will extend when completed from the Champs-Elysées to the Esplanade des Invalides in one unbroken continuity, of a length and vista probably unsurpassed by any other public avenue in the world. The bridge itself consists of a number of steel arches of a span of 360ft., pivoted at the springings upon the usual modern rocker plate and rollers, and clearing the narrow breadth of the Seine at one leap. Caissons were employed in getting in the foundations of the abutments, with the aid of the compressed air process. They were sunk through the superincumbent strata, until firm ground was reached; not in the great bed of clay forming the basin of Paris, as has been stated, but in a massive compact calcareous forma-

tion. These caissons are among the largest ever constructed, measuring 155ft. by 120ft., giving a working area of 16,500 square feet, and weighing each 3820 tons. They were built up on the site, and are composed of tier upon tier of steel plates. At present both the caissons have been filled with concrete, and the masonry above is being carried up as rapidly as circumstances will allow, while the steelwork is in process of riveting up in the workshops of the manufacturer.

A visit to the Champs Elysées will convince the traveller that, in point of importance, the next place may be considered to be adequately filled by the two palaces in course of erection, and intended to serve as receptacles for the fine arts. They are situated along the great avenue which the Alexander Bridge opens on, and are built partly upon the site occupied by the old Palais de l'Industrie, demolished to make room for the new edifices. The smaller of these two buildings will be devoted to a retrospective exhibition of the fine arts, and will ultimately become the property of the city of Paris, and be utilised as a national museum. Although not commenced until the month of October in last year, the whole of the ground-floor has been finished, and the upper storey is rising rapidly. Owing to the presence of several alluvial deposits, it was necessary to pile certain parts of the foundations, especially those adjoining the Seine. Whether this practice is to be universally commended or not, is perhaps doubtful. Some engineers under the circumstances might say, pile all or pile none; because a small general and regular settlement would be much preferable to one of an irregular and un-uniform character, which would crack, and possibly split the walls at the junctions of the piled and unpiled parts of the structure. Ten thousand cubic yards of concrete were used in one month in completing to a depth of 20ft. below the ground level the foundations of the smaller palace, which covers an area of 55,000 square feet. All the floors, upper and lower, are built on the Henebrique compound system of concrete and steel, varying in span from 20ft. to 25ft. The loads the floors have to carry are estimated at 160 lb. and 240 lb. per square foot for those constructed of arches and those of girders respectively. The erection of the great palace of fine arts is in some parts rather further advanced than that of its smaller neighbour, insomuch as some of the lofty arch-pierced walls separating the different apartments are raised to a considerable height over the crowns of the arches. A very fine view of the Eiffel Tower can be obtained from the site of this building. Nothing appears to have been definitely decided as yet respecting the circular narrow-gauge railway for the transport of visitors to and from the Champs-de-Mars and the Esplanade des Invalides. Five schemes were put forward, only one of which proposed a double track line of a gauge of 4ft. 8½in. Three of the designs submitted favoured the construction of a single track on the metre gauge, while the fifth advocated, in conjunction with the electric railway, the use of movable sidewalks, which were employed with satisfactory results at the Exhibitions of Berlin and Chicago. It has been demonstrated that passengers can get on and off these platforms without running any risk of personal injury, so long as the speed does not exceed 1¼ miles per hour. It may be mentioned that the plans have been completed for the construction of the Palace des Armées de Terre et de Mer, and the work put in hand. The building is situated along a part of the Quai d'Orsay and the banks of the Seine, and has an area of 15,400 square feet.

A word about the cost of this magnificent undertaking, and the manner in which the total is distributed by the Administration among the principal separate items, will not be foreign to our subject. The original estimate was calculated at £4,000,000 of our currency. Of this amount £2,920,000 was apportioned among the different works of construction, £480,000 was placed to the credit of maintenance and working expenses, £320,000 was assigned for the administrative department, and the sum of £280,000 was kept in reserve for unforeseen and special contingencies. In the annexed table the separate works, together with their accompanying approximately estimated costs, are set out more in detail:—

| Description. | £ |
|---|---|
| Fine art palaces in the Champs Elysées ... ... | 980,000 |
| Palace in the Champs-de-Mars ... ... ... ... | 740,000 |
| ,, in the Esplanade des Invalides ... ... | 208,000 |
| Cost of new quays ... ... ... ... ... ... | 64,000 |
| Bridges over the Seine, including the Pont Alexandre III. ... ... ... ... ... ... | 200,000 |
| Appropriation of quays and landing-places of the Seine ... ... ... ... ... ... ... | 140,000 |
| Mechanical and electrical service ... ... ... | 270,000 |
| Cost of electrical railway ... ... ... ... ... | 60,000 |
| Lighting and illuminating ... ... ... ... ... | 32,000 |
| Fountains, gardens, and decorations ... ... | 48,000 |
| Meetings and public fêtes ... ... ... ... ... | 220,000 |
| Retrospective exhibitions ... ... ... ... ... | 60,000 |
| Musical department ... ... ... ... ... ... | 40,000 |
| Expenses of juries and awards ... ... ... ... | 40,000 |
| Provision for exhibits of working men ... ... | 16,000 |
| Cost of tickets, programmes, &c. ... ... ... | 32,000 |
| Customs, police, and fire service ... ... ... | 60,000 |
| Cost of administration ... ... ... ... ... | 160,000 |
| Gardens and plantations ... ... ... ... ... | 60,000 |
| Reserve fund ... ... ... ... ... ... ... ... | 280,000 |
| Balance ... ... ... ... ... ... ... ... ... | 290,000 |
| Total estimate ... ... ... ... | £4,000,000 |

It will be at once observed that the erection of the two new palaces in the Champs Elysées take the lion's share of the funds provided, though the cost of the palace in the Champ-de-Mars is not much below that of its two neighbours. In addition to the chief features of the Paris Exhibition herein recorded, the main railway companies are busy making connections with the site and adjoining districts. The Orléans Company has commenced the extension which will join their line up with the Quai d'Orsay, and the Western Company is progressing rapidly in the direction of the Invalides. This latter company has also, with a special regard for the enormous development of traffic which will of necessity result in the year 1900, doubled the number of its tracks on the Auteuil branch between Courcelles and Passy, and continued the widening to the junction at Moulineaux. It will also build rather a striking-looking bridge over the Seine, to which we shall probably return on another occasion.

## THE INCORPORATED GAS INSTITUTE.

### ANNUAL GENERAL MEETING.

The thirty-fifth annual general meeting of the Incorporated Gas Institute was held at the Exhibition Hall, Botanic Gardens Park, Belfast, on the 21st ult., and the two following days, under the presidency of Mr. James Stelfox, M. Inst. C.E., the Gas Engineer to the Belfast Corporation. The members were welcomed to Belfast by the Right Honourable the Lord Mayor, and after the transaction of private business, the President gave his inaugural address. He commenced a review of the position and prospects of the gas industry, with a patronising glance at the progress of electric lighting. He predicted that recent improvements in incandescent gas burners, which he referred to at length, would enable gas to compete successfully with electricity as an illuminating medium. He briefly considered the merits of various agents for the enrichment of coal gas, and expressed a preference under ordinary circumstances for carburetted water gas, of the manufacture of which he had had four and a-half years' experience. The Belfast Gasworks were, indeed, among the first in the United Kingdom at which carburetted water gas was adopted as an enriching agent and a supplementary supply. The hygienic aspects of water gas, both carburetted and uncarburetted, he discussed very fully, and disposed of the objections raised in many quarters to the use of this gas even when subject to reasonable precautions. He thought water gas a very suitable fuel for motors for tractive purposes, and referred to the employment of compressed coal gas for tramcar traction.

The address was a good one, but was better adapted for presentation to a general audience than to a body of men to whom the subjects were perfectly familiar. It lacked the detail which would have given them food for reflection, and would have raised the address from the level of a popular lecture by a master of his subject. Mr. Stelfox has in the past contributed ably to the technical literature of the gas industry, and his presidential address was distinctly disappointing to those familiar with his earlier work. Another address of a semi-popular nature was given on the following day by Professor Vivian B. Lewes, who chose, "Acetylene; its Modern Developments" for his theme. The ground he covered is now familiar to all who have followed the copious ephemeral literature on acetylene which he, more than any other lecturer, has recently provided in abundance.

Of the papers presented at the meeting, only two dealt directly with the manufacture of gas. Mr. S. Y. Shoubridge described the installation and working of inclined retorts at Salford. Some of these retorts in settings of nines were erected in 1893 and others in settings of sevens in 1896. The smaller settings have proved more satisfactory. In both cases, retorts 18ft. in length, and set at an angle of 32 deg. to the horizontal, have been used, and the charging stages are at the sides of the house. The charging machine has three measuring chambers, and three sliding shoots fixed at the same relative height above the tiers of retorts. The chambers are filled with coal from an overhead hopper, and the charging machine is then run along an overhead tramway in front of the bench of retorts. The device enables every retort to be charged with coal falling from a uniform height above it, and is, in this respect, much superior to the original Coze setting, in which the coal descended through shoots varying in height with the levels of the retorts. The charging at Salford is said to be effected evenly and with certainty, and the carbonising results with the inclined retorts are said to equal those obtained with horizontal settings. The inclined retorts show a saving in wages of about 1½d. per ton of coal carbonised over horizontal retorts with hydraulic stokers, and of 1s. 0¾d. over horizontal retorts charged by hand. Mr. Shoubridge's paper gave a straightforward statement of the working of one of the best installations of inclined retorts in the country, and was the most useful communication laid before the meeting.

The second paper which dealt with manufacture, was by Mr. Henry Green, of Preston. The subject was "The Construction of and Mode of Working Purifiers," but in reality the scope of the paper was limited to a description of an installation of dry-sealed purifiers at the Moor-lane works at Preston, and of the partial purification of gas in these vessels by bog oxide and lime The covers of the purifiers comprise a number of lids, made gas-tight by means of strips of vulcanised india-rubber. The lids are of small size, and from four to 12 are provided for each purifier, according to its dimensions. Each lid weighs only 26½ cwt.; therefore they are easily removed from the vessels for discharging and recharging. The author appeared to have experienced much trouble from the blowing of shallow hydraulic lutes, and had therefore adopted dry-sealed purifiers when reconstructing a portion of the works under his charge. The use of a number of small lids to one large vessel appears to have been rendered necessary by the difficulties of dry-sealing a large lid and of staying large vessels. The system seems to have answered well in the particular case described by Mr. Green.

The other papers presented at the gathering had no direct bearing on gas manufacture. Mr. R. S. Carlow, of Arbroath, who is secretary of the North British Association of Gas Managers, gave the meeting the views of the committee of that body as to the most suitable sizes of meter unions for adoption as standards. The sizes approved by the committee have been found to differ from a set of standard unions prepared for the Standards Department of the Board of Trade in 1888; and the committee learned recently that the latter standards would be legalised. As the general desire of gas managers has merely been to secure the adoption of some standard unions which would be approved by all parties, the committee of the North British Association did not press for the recognition of the standards proposed by them. The action of the Board of Trade in the matter is anxiously awaited by both gas managers and meter makers.

Mr. J. T. Sheard, the chemist to the Sheffield United Gas Company, presented some useful laboratory notes chiefly dealing with gas analysis, but his paper was taken as read owing to lack of time. Mr. R. G. Shadbolt, of Grantham, compared the cost of lighting villages by coal gas, and by electricity generated by means of oil engines. So long as gas is consumed chiefly in open flame burners, electricity can compete with it on fairly equal terms for the lighting of villages, provided refined Russian oil can be obtained at about 4½d. per gallon. Mr. W. F. Cotton suggested that a number of amendments in the Gasworks Clauses Acts of 1847 and 1871 were necessary for the protection of gas undertakings, and Mr. W. Newbigging discussed the subject of the "Valuation of Gasworks for Assessment." Mr. C. S. Ellery, of Bath, who was President of the Institute last year, read a communication on "The Workmen's Compensation Act, 1897." He arrived at the conclusion that a rate of three shillings per cent. on the wages paid would amply cover all risks on the new schedule of rates set forth in the Act. This rate is considerably lower than those now quoted by insurance companies for the risk.

The communications made to the meeting were, on the whole, rather uninteresting to the gas engineer, and manufacturing and engineering topics were certainly inadequately represented among the subjects of the papers. Visits to the shipbuilding yards and other works at Belfast were paid during the afternoons of the days on which the meeting took place, and an enjoyable excurion to Rostrevor was made on Friday, the 24th. The arrangements for the gathering were very ably planned and carried out.

## RUSSIAN RAILWAY EXTENSION.

Amid the general activity displayed of late by Russia in developing the railway system of the empire, the Baltic Provinces have not been neglected. For some time Russian naval authorities have been busily engaged in making the port of Libau, in Courland, a strongly-fortified naval station, and it is expected that much of the shipping will in consequence be diverted from that port. To meet this contingency the Engineering Committee of the Russian Ministry of Ways and Communications has recently issued a report with regard to the improvement of the little harbour of Windau, which lies sixty miles north of Libau. A small branch line, thirty-five miles in length, runs round the southern shore of the Gulf of Riga, and connects Riga with Tukum, and the line is now being extended from the latter place to Windau, a distance of about seventy miles. This new line will be ready for traffic at the end of this year, and the station buildings and houses of the employés have yet to be erected. It was very much open to doubt whether, in view of the unfavourable nature of the past winter season, due progress could be made with the work of construction, since the transport of the necessary material, *e.g.*, stone, timber, &c., was attended with the greatest difficulties, and the work proceeded very slowly. Nevertheless, at the end of January the weather improved, and the winter roads were better, so that now the completion of the work in due time is assured, although immense sums of money may have to be expended. During the last few weeks the work has not been pushed on at such high pressure as was the case, since the winter task of driving the piles for the bridges is nearly finished. In the first and third sections excavations are already in progress, and a start will soon be made with those of the second and fourth sections. So soon as the earth is sufficiently dry after the winter snows the work will be pushed on with increased vigour, and during the summer about 6000 men will be at work upon the line at one time.

The work during the winter, and especially the pile-driving for the bridges, was done chiefly by native workmen. For the excavations workmen have been summoned almost exclusively from the Western Governments of Russia, while the masons and stone-cutters come from the central Governments. The stretch of country from Tukum to Windau, through which the new line will run, is for the greater part low-lying, and abounding greatly in lakes, rivers, brooks, and marsh land. In no part of the district of Windau is the land more than 100ft. above the sea level, and it contains more swamps than any other district of Courland. Although these swamps are not present along the whole extent of the new line, yet they are the sources of many small streams and brooks, over which it has been found necessary to throw an immense number of bridges. No less than eighty-three bridges, or one bridge for every 1500 yards, will have to be built, as also seven locks for regulating the outfall of water. The three longest bridges are each 60ft. in length, and the next three are 48ft., 42ft., and 36ft. long respectively. One of the 60ft. bridges, near Tiruksch, presented the greatest difficulties, because the soil there is very marshy, and it was a work of much difficulty to transport the building material to the spot.

A Big Gun.—The 16in. coast defence gun, for which parts are now being made at Bethlehem, Pa., will, according to United States opinion, be the most formidable piece of ordnance in the world. This gun will be mounted at the entrance to New York harbour, probably in a turtle-back turret on Romer Shoals. The designer of the gun, Mr. J. F. Meigs, calculates that the striking energy of its 2350 lb. shell, propelled by 1000 lb. of powder, will be 60,000 foot-tons. The estimated range of the gun is sixteen miles, and the programme calls for fourteen of these guns mounted in the forts about New York. A comparison with the great guns of other nations would stand as follows, as taken from a table prepared by Lieutenant W. H. Jaques, United States Navy, for the Select Committee on Ordnance and Warships of the United States Senate, and from a list made by Lieutenant Cardon:—

| Countries | Calibre, in. | Gun tons. | Length, ft. | Shell, lb. | Powder charge, lb. |
|---|---|---|---|---|---|
| United States (1898) .. | 16 .. | 126 .. | 49·1 .. | 2350 .. | 1000 |
| England (1883) .. .. | 17 .. | 108 .. | 46·8 .. | 2000 .. | 882 |
| ,, (1884) .. .. | 16·25 .. | 110 .. | 41·8 .. | 1800 .. | 900 |
| Italy (1880) .. .. .. | 17·42 .. | 100 .. | 32·7 .. | 2000 .. | 551 |
| ,, (1882) .. .. .. | 17 .. | 100 .. | 39·7 .. | 2000 .. | 772 |
| Germany (1890) .. .. | 16·50 .. | 120 .. | 45·9 .. | 2204 .. | 903 |
| France (1890) .. .. | 16·54 .. | 74·2 .. | 32·5 .. | 1719·6 .. | 595 |

It may be remarked, however, that on the whole experience with these gigantic weapons has not been satisfactory; 12in. appears to be as large a bore as is desirable.

## LORD DUNDONALD'S MACHINE GUN CARRIAGE.

WE reproduce a photograph of the machine gun carriage designed by Colonel the Earl of Dundonald, commanding the 2nd Life Guards, which was recently exhibited and worked in its present form in Windsor Park, and which had been previously tried in a rougher and more elementary form at Aldershot. It will be readily understood that the work and scope of a machine gun attached to cavalry is peculiar. There are moments when it may be of great importance for cavalry in the advanced position they occupy to bring a concentrated stream of fire on to some point, such as a road or bridge, and this is done by a machine gun in a way that nothing else can do. Other occasions of a more exceptional character may arise. Machine gun fire might precede a charge. For example, at Balaklava a mass of Russian cavalry suddenly appeared over the crest of a hill on the flank of the scarlet heavy brigade which was moving in regiments partly in open column of troops and partly by threes. As we all know, the Russians halted, and gave time for the heavy brigade to wheel into line, or, strictly speaking, into separate lines, and charge in succession as quickly as they could. Machine guns could have come into action instantly on the Russian column, and we think with such effect that probably we should never have had the heavy cavalry charge at all, or it would have been delivered on a broken mass. Circumstances would not always be so favourable. A notable charge of French cuirassiers took place at Sedan. This was delivered against infantry and failed, owing to the terrible fire of their breech-loading rifles. Machine gun fire might doubtless have prepared the way for a more hopeful attempt, but whether men or machine guns could live in the face of the fire of infantry depends on circumstances. Perhaps if the cavalry were awaiting the advance of infantry so that there was the opportunity to use a spade, the machine gun with its shield might hold its own, but this is rather the work of infantry machine guns than cavalry. The call for the latter is sudden, and the opportunity very brief generally, but it may be of decisive importance. Further, it is obvious that the carriage must be capable of following cavalry wherever they may go, or the cavalry may be crippled in their movements, or may possibly sacrifice men to save the piece at some critical juncture. We have said so much in order to show, first, that a machine gun may perform very important service with cavalry; and secondly, that the first necessity is power to follow cavalry anywhere. The first condition may be said to be settled already by the decision which appoints machine guns to cavalry in a certain proportion. Lord Dundonald, in fact, is not called upon to show that machine guns are desirable, but rather to insist on the desirability of their being made in such a shape as to accompany cavalry everywhere, and in the case of success in this, it may naturally follow that the number may be increased with advantage. Horse artillery, we know, accompany cavalry with actual gun carriages, but not in the sense in which the machine guns might be made to do so. No sane horse artillery officer would thrust his guns into close proximity to infantry or cavalry in cramped places. His business is to act with cavalry, and support them beyond direct horizontal musket range if engaging infantry, and in open ground when acting against cavalry. Even if overtaken and cut off by a sudden rush of cavalry, a battery of horse artillery at close interval, with the horses, as it were, linked together and unable to open apart, coming along with wheels behind them, is very difficult to stop. To form men in front of these is to expose them to certain death. Cavalry going at a gallop is wild work. Lancers might get in gradually from a flank, but the opportunity is probably very brief, and in the open we think Norman Ramsey's success in getting through might probably be repeated. All this, however, deals with a different zone of work from what we contemplate for machine guns. The horse artillery battery is to the machine gun what the outpost is to the vedette. A machine gun might well be sent singly along a narrow road and crammed into some spot where it might do admirable work. It might be lifted over stiles or pushed through gaps in English country, if made sufficiently light and handy. On the other hand, it might be made so heavy as practically to be able to do little that the horse artillery gun cannot do, with the disadvantage that its range confines it to the zone of danger that artillery proper should seldom enter. This follows from the fact that the calibre of the machine gun is that of the infantry rifle. The task that Lord Dundonald has set himself then is one with which we entirely go. It is to furnish the cavalry with a piece so light that it can carry out the *rôle* that we have indicated, in contradistinction to the present Maxim gun on a carriage drawn by two horses, weighing 9 cwt. Lord Dundonald's gun and carriage weigh, we understand, 400 lb. It can be drawn easily by a single horse at a gallop, and can be easily moved and fired by one man. It must also follow that it is much more quickly got into motion from the halt than a heavier piece, and this adds greatly to its power of doing the work we contemplate. Those who have seen cavalry rush for guns as they limber up and move off, must have noticed the terrible way they close on them before the guns get fairly under way.

Our engraving shows the gun limbered up, if the expression is allowable. Limbering up or attachment is effected by entering the end of a hollow steel bar which forms the trail of the gun into a cup on the central point from which the shafts spring, into which it is secured by a bolt. The socket in which it enters is capable of rocking on a pivot through a sufficient angle to facilitate limbering up, by accommodating the socket to the bolt just as it presents itself. The shafts are made of hickory or lance wood and steel. They are placed on to the ordinary service breast harness and breeching, the points entering leather sockets just below the shoe pocket behind the rider's leg—see illustration. Lord Dundonald recommends three mounted men being told off to two guns. One would take the two horses when the pieces are in action, pointed and loaded by the other two.

LORD DUNDONALD'S GALLOPING GUN CARRIAGE

The carriage, it will be seen, is very light; including the gun and 1500 rounds of ammunition, it weighs 400 lb. There is a light steel shield fixed on the gun which resists musket bullets. It will be seen that the track of the wheels is wide, the trail being attached to the shafts by a bolt furnishing a horizontal pivot; the wheels adjust themselves readily to great inequalities of ground without causing the carriage to capsize. This is, we believe, the best means to this end. Sir George Clarke's service wagon, consisting of two two-wheeled parts connected on this principle, exhibited the same property. We understand that Lord Dundonald's carriage has been forced over boxes and obstacles without upsetting.

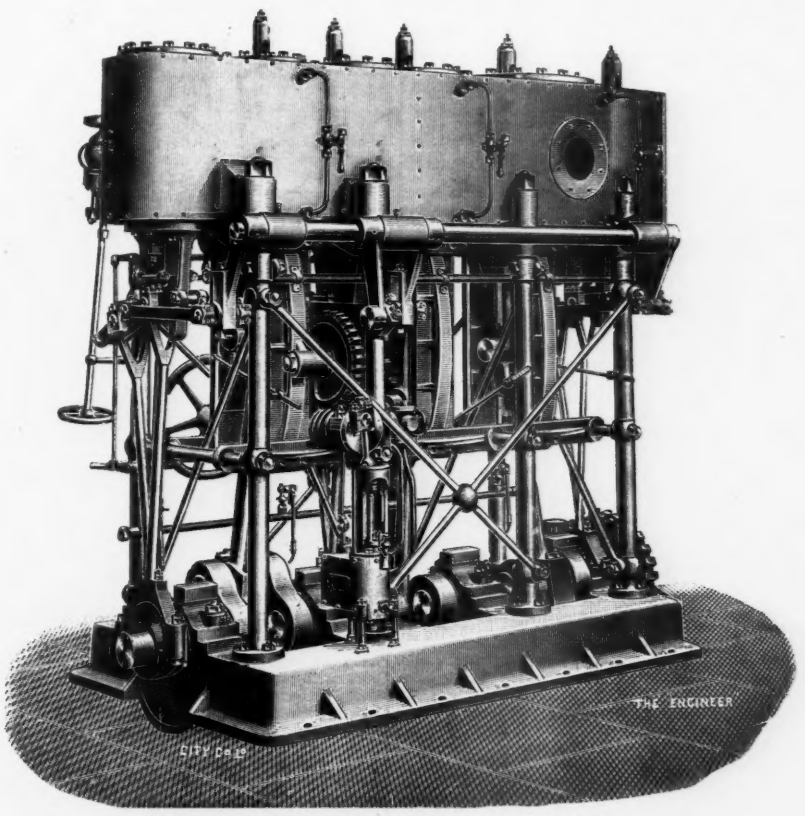
Having said so much, the question arises as to faults and possible improvements. Without seeing an actual trial it is impossible to say much to the purpose. We believe that the first carriage tried was not thought sufficiently strong in all respects, but it was not the present pattern, and it is almost certain that in designing a carriage as light as service requirements allow some experience is needed. In fact, it goes without saying, seeing that a machine gun is to accompany cavalry. The question is, should it be a very light piece of this kind. We go with Lord Dundonald's view that it should be very light indeed, for the reasons we have given above. We, in fact, consider a very light piece, which can accompany cavalry anywhere, a very valuable adjunct, whereas a heavy piece is a doubtful gain, and might positively prove mischievous.

## THE MANUFACTURE OF HOLLOW EARTHENWARE.

THAT time-honoured appliance, the potters' wheel, whose existence has been traced back to the time of the ancient Romans, appears likely to have to go the way of many other picturesque institutions—"to the wall;" at least, as far as the manufacture of cylindrical earthenware vessels is concerned. Though regret may be felt at its disappearance, small profits and acute commercial competition have resulted in the production of a machine such that not only is the output of cylindrical earthenware vessels increased manifold, but a more uniform product both as regards contour and density of mass results. Although the formation of simple cylindrical objects out of clay by machinery is a comparatively easy matter, unfortunately for the success of past attempts this is only "half the battle," the great obstacle being to induce the articles when formed to leave the disc in a perfect state. The credit of successfully attacking the problem seems to be due to Mr. West, of West's Patent Pottery and Machine Company, Walthamstow. After some years of patient work and experiment, this gentleman has now produced a machine, which we have seen at work turning out flower pots of many sizes at a speed of between 5000 and 6000 per working day of ten hours. The machine, besides acting as a press, has quite a number of circular motions for giving a finish to the pot, and preventing the clay from adhering to the mould. The male die or plunger revolves simultaneously with the pressing movement, and by an ingenious device attached to it, trims off the upper edge of the pot and frees the latter. The female die has a rising and falling motion, and a neat device attached to its lower end causes the finished pot to move through part of a circle before it is automatically raised by the ejector, whereby any tendency to adhering is obviated. Prior to entering this machine, it should be stated that the clay is ground up in a mill, and in a plastic condition is formed into "clots" of a size suitable for the pot to be made. Needless to say, the machines are not restricted to the manufacture of flower pots, and should be easily adaptable to the manufacture of telegraph insulators, crucibles, jam pots, or, indeed, any articles of domestic ware made from plastic material. The saving effected in the moulding of the articles is, it is claimed, in itself a very considerable item, but there is a further economy, the reduction in the time required for drying and slow burning, which brings the cost of manufacture down to a minimum.

## TRIPLE-EXPANSION MARINE ENGINE.

WE illustrate below a type of high-speed triple-expansion marine engine, made by Alexander Shanks and Son, Limited, of Arbroath, N.B., and London. The particular engine from which our engraving was made has cylinders 10in., 15½in., and 26in. diameter respectively, by 16in. stroke, and is one of twin engines arranged to work along with a separate condensing plant. Each engine develops 320-horse power, with 160 lb. steam pressure at the stop valve, and at 225 revolutions per minute. The design is specially adapted to all cases where high powers are expected from quick-running propellers of small diameter. The bearings are specially large and well lubricated. The engine is built with polished steel columns at front and back, well stayed in both directions, and thus lightness is secured as well as considerable strength. Steam reversing gear of the "all-round" type is fitted, the small engine being arranged vertically on the sole-plate at the back. The crank shaft, with three cranks at 120 deg., is of mild steel, built up; the usual double-bar adjustable link motion is fitted, and all details are in accordance with modern practice.




320-HORSE POWER TRIPLE-EXPANSION MARINE ENGINE

IN an account of the Linde process of liquefying air, recently presented before the Paris Academy of Sciences by M. d'Arsonval, it was stated that an expenditure of rather less than three-horse power gives a litre of liquid air per hour.

## ENGINEERS AND SHIPBUILDERS OF SCOTLAND IN SHEFFIELD.

In our last impression we brought down our report of this meeting to the end of Mr. Weir's paper on water-tube boilers. A paper prepared by Mr. George Halliday, London, on "The Transmission of Heat through Plates from Hot Gases to Water," was then submitted by that gentleman. As printed copies of both this and Mr. Weir's paper were in the hands of members, and as time was limited, the author merely presented the briefest abstract of his paper, which was of a highly scientific character, with formulæ and tables of data, and not lending itself to ready condensation. We hope to reproduce an abstract in a future issue. The only speakers on the paper were Professor Watkinson, Glasgow, and Mr. Stromeyer, Manchester, the former of whom thought that the subject of heat transmission through metal plates was one that was sufficiently understood. Matters which were of more vital importance, and which were not yet understood by any means, were the phenomena concerned with the transmission of heat from the hot gases to the plate, and from the plate to the water on the other side. A proper understanding of such questions was of the greatest importance in the design of boilers, and he would have liked them to have been fully gone into by the author. There was a written contribution to the discussion from Dr. John Perry, of the Royal College of Science, London, which took a somewhat different view of the character of the paper, but this was not read. Both Mr. Weir and Mr. Halliday were thanked for their papers, and it was made clear that in both cases members who had any further remarks to make should do so in writing to the secretary. The authors would reply fully to the criticisms offered at a future meeting of the Institution.

Professor Arnold, of the Sheffield University College, then delivered a lantern lecture on "The Internal Architecture of Metals," in the course of which he said that the science of metallography was born in Sheffield thirty-five years ago. The patient pioneer work of Dr. Sorby was, however, received with indifference by the metallurgists of this country, and although, as might be expected, it to some extent took root in Germany, the plants raised there were of somewhat sickly growth from a practical point of view. About ten years ago the metallurgical department of the Sheffield College began to develope the work of Dr. Sorby in earnest, and to apply it to practical use. The results obtained were such that the science had now become of international application. The old idea that the mechanical properties of metals depended upon molecular cohesion was now exploded, and it was recognised that intercrystalline cohesion was the more important factor. Micro-sections were shown on the screen, proving that the intense weakness produced in gold and copper by minute percentages of elements like bismuth was due to the formation of films of alloy between the grains of the pure metal; in other words, the stones of the metallurgical structure were held together with exceedingly weak mortar. The growth of iron into steel as the carbon increased was next exemplified by a series of slides. It was a fact of importance in connection with structural steel to remember that a critical mechanical point existed at 0·45 per cent. of carbon, where in pure materials the metal consisted of a mixture of equal parts of crystalline grains of iron and steel. Above this point, say at 0·6 per cent. of carbon, the steel grains preponderated, and gave the mass steely properties; below this point, say with carbon 0·3 per cent., the iron crystals were in the majority, and the mass possessed the ductile properties of iron rather than the tenacious and brittle properties of steel. The striking structural changes brought about by annealing steel castings were also shown. The lecturer then detailed some instances in which an investigation of the internal structure of metals had been put to practical use in clearing up mysterious cases of failure. One was the case of a fractured screw shaft, another of a fractured crosshead belonging to the engines of a battleship, and a third of a fatal steampipe explosion on board the s.s. Prodano. In the last case, as will be remembered, the Board of Trade Court decided that the explosion was due to an originally faulty pipe, but the matter was referred to the lecturer and the Committee of Lloyd's Register of Shipping. After four months' investigation it was proved that the brazing of the pipe had been deteriorated by the electrolytic action of impure oils till it became quite brittle and weak, so that after seven years' use the pipe exploded for a length of 6ft., at a pressure of only 130 lb. per square inch. The lecturer concluded with a reference to the importance of research, in which the Germans were so far ahead of us as a nation. Students must not expect their research work to meet with any genial reception from the pure scientific societies of this country, but must learn to love it for its own sake. Good work would always come to the front in the end, as was evidenced by the work of Dr. Sorby, which, after lying fallow for a quarter of a century, was now of universally recognised importance.

A brief discussion followed the delivery of Professor Arnold's lecture, interest apparently being chiefly centred in what had been said as to the Prodano case. Mr. James Gilchrist, Glasgow, doubted the truth of explanations based on the assumption that fatty acids had formed in the burst steam pipe from the use of vegetable oils or tallow as lubricants, and he took this view apparently because he found it hard to believe that such stuff could have been used. He preferred to suggest that the deterioration of the copper was due to the alternating temperatures to which the metal was subjected, and that what was wanted—what, in fact, was already being extensively adopted by marine engineers—was a material for steam pipes altogether different from copper. Mr. James Mollison, Glasgow, thought that if the presence of fatty acids accounted for the bursting of the pipe the fact would throw upon the sea-going engineer a further responsibility and burden in respect of the close surveillance necessary in the use of animal and vegetable oils. Mr. James Mercer, Manchester, took exception to Mr. Gilchrist's idea that because the brazing of copper pipes had proved unsatisfactory, engineers were justified in flying to pipes of other material than copper, and hinted that a little more liberality in the prices paid for copper pipes would ensure a better article.

The party visiting the electro-plating works of Messrs. Walker and Hall, on Wednesday afternoon, included a considerable number of ladies, who were, to say the least, quite as deeply interested in what was shown as were the male members. The visitors were received by Col. J. E. Bingham, Mr. C. H. Bingham, and Mr. A. E. Bingham, who at once put all the available members of their large staff at the disposal of the visitors to go round the great pile of buildings and explain the various processes in operation. This firm, which is the largest of its kind in Sheffield, if not elsewhere, employs about 1100 people, and the whole operations connected with this business are conducted under one roof. At first the visitors were conducted through the handsome show-rooms containing the finished articles in silver, electro-plate, &c., and were then taken into the stamping-room, where drop hammers, actuated by both hand and power, were stamping out various patterns of all kinds of dishes for table use. Every process in the manufacture of silver and electro-plated goods of all kinds was shown, and the numerous little peculiarities connected therewith explained. Knives and forks were first seen in the rough, and then in a succession of rooms was shown how the well-known Sheffield articles pass through an almost countless variety of processes before they become the finished article ready for the table. One of the most interesting of the operations shown was that of metal spinning. In the silver departments the work of engraving and chasing was particularly admired, and in the matter of polishing the silver, some of the ladies without doubt took away a few ideas that will help them in the keeping of their own cherished stock. Before leaving the visitors tendered a hearty vote of thanks to the firm, which was acknowledged by Col. Bingham, and as they passed out each received a very chaste gilt pendant as a souvenir of the visit.

The forenoon of Thursday was entirely given up to the visiting of works which were open for the inspection of members of the Institution. While one or two of the members were for special reasons excluded from some of the works, the larger majority were kindly welcomed, and every preparation made for their reception and conduct through the works. While there was quite a number of works open to members, advantage of which was only taken by a few of the members individually, and as they found time, regularly organised parties visited the following:—The River Don Works, of Messrs. Vickers, Sons, and Maxim, Limited; the Norfolk Works of Messrs. Thomas Firth and Sons, Limited; the cutlery works of Messrs. Joseph Rodgers and Sons, Limited; the electro-plating works of Messrs. Mappin and Webb; the Clyde Steelworks of Messrs. Samuel Osborn and Co.; and the Dannemora Steelworks of Messrs. Seebohm and Dieckstahl.

By far the largest contingent of members elected to visit the works of Messrs. Vickers, Sons, and Maxim, the number, indeed, being greater than in the case of visits paid to any other works during the stay. The party, moreover, was thoroughly representative of the Institution in all branches, and not a few of the members who are intimately associated with kindred establishments in the West of Scotland were present, several of them being openly shown every courtesy and recognition. Notably was this so in the case of Mr. James Riley, of the Glasgow Iron and Steel Company, who was a foremost and not the least interested spectator of the various operations. On arrival the visitors were received by Colonel Vickers and the heads of the various departments, and cards were distributed detailing the order of procedure. The process of armour-plate rolling was the first thing shown. A steel slab of about forty tons weight was withdrawn from the furnace alongside the huge rolling mill, where it had been for twenty-four hours. Promptly taken hold of by the grabs of the 150-ton overhead crane, the red-hot mass was speedily placed on the live rollers and conducted forward and backward through the rolls. The mass, at first 36in. thick, was in about twenty minutes reduced to the required thickness of 14in., and thereupon lifted by the crane grabs and placed upon a bogie with engine attached awaiting it, and thus taken smartly to the hydraulic press in the shop adjoining. This shop is of great height and spaciousness, and is equipped with an overhead crane of equal power to that seen at the rolling mill. The press is of 8000 tons capability, and by it the plate was pressed down over two parallel knives projecting from the anvil, which cut the mass upwards through half its thickness. Two knives were now placed on top of the mass, and pressed through almost to meet the cuts already made. Both under and upper cuts were made with surprising ease, the strip of metal falling within the two parallel knives being intended for test purposes. The rolling and severing of armour plates having been thus exemplified, the visitors were conducted to the shops in which the work of ripping, planing, and drilling the plates was being carried on. The spaciousness, lightness, and cleanliness of these shops were matters of common remark, and their equipment with machine tools of the heaviest and most modern character was greatly admired. Many of the tools seen at work bore the names of well-known West of Scotland makers, and a feature with which visitors were much struck was the extent to which the principle had been carried out of leaving the cutting tools to adjust themselves to the work to be done, instead of shifting the work to suit the rigid position of the tool. After leaving the planing shop, the visitors were shown the process of hardening a gun forging, a steel tube 42ft. long. They saw it taken out of the vertical gas furnace, and, by means of a very lofty overhead crane, drawn over a deep pit completely filled with oil, into which the red-hot tube was quickly lowered. Leaving the forging to cool in its bath, the company were taken next to the tire-rolling department, where the process of making tires for engines, wagons, or tramcars, from the hammered billet to the tire as finished in the tire mill, was closely inspected. From the tire-making department the visitors passed through the hammer shop, and then into the gun shop. This being practically a new industry for Sheffield, attracted a good deal of attention, and enabled those who have been privileged to go through the gun factory at Woolwich to appreciate the improvements that have been made in this department of ordnance manufacture within recent years. When the visitors arrived a ponderous ingot already bored to something like 18in. or 20in. in diameter was being drawn from the furnace. It was placed under a 4000-ton hydraulic press with semicircular pressing tools, and by these squeezed down to form ultimately part of the body of a 12in. gun. Leaving the gun forging to be further dealt with, the party passed on to the shop where the guns already forged were undergoing various processes before being completely finished. Some were being bored, others planed and rifled, and others were all polished and ready for the breech mechanism. Here also was seen the new form of interrupted screw which this firm has introduced into the breech mechanism of the large guns. While it is as easily worked as the old system, this new feature, it is maintained, gives additional strength, and enables it better to bear the strain of the new high explosives. From this the visitors looked into the turning shop, where large guns were being operated upon in a way which well exemplified the effective power of modern machinery. An outstanding feature of these shops consisted in the fact that all the tools, either singly or in groups of two or three at most, were driven by electric motors. The absence of revolving shafting pulleys and driving belts, and the openness and neatness of the whole shop in consequence, was remarked upon by many of the visitors, who saw in the development of electric-power driving, as here exemplified, a striking object-lesson of what should and doubtless may in course of time, obtain in marine engineering establishments. Sir William Arrol, before the visitors left the works, thanked Colonel Vickers on their behalf for the kindness he and his firm had shown, and for the privilege that had been accorded them.

The Norfolk Works of Messrs. Thomas Firth and Sons, Limited, were visited on Thursday by a section of the members, and by smaller parties on other days, through special arrangements with the members of the firm and head officials. The works consist of the following separate departments:—The Norfolk Steelworks, shot forge, clay wheel forge, west gun works, east gun works, foundry and file saw and edge-tool works, and cover nearly twenty acres of ground. The number of men employed is about 2000. The total steam power is 3000 indicated horse-power, and there are thirty-seven steel boilers, mostly 30ft. long and 7½ft. to 8ft. in diameter. On Thursday the operations witnessed were varied and interesting, and representative of the chief classes of manufacture for which the firm is noted. In the Siemens department was shown the process of casting a 50-ton steel gun ingot from two 25-ton Siemens furnaces. Besides these two 25-ton furnaces there is another of 10 tons capacity, and with these, ingots up to 60 tons weight can be produced. The furnaces are served by a 100-ton travelling crane, as well as by several smaller ones used for the lighter work. In the east gun works there was shown the operation of forging the 50-ton ingot with the firm's hydraulic press, which is of 3000 tons capacity. The forging press is served by two 50-ton cranes, and amongst the items which have already been turned out here, are marine shafts up to 30in. diameter and 40-ton forgings for the tube of the 110-ton gun. At the present time the firm have many gun forgings in course of manufacture for various sizes of guns, notably for 12in. breech-loading guns. In the west gun works marine shafting was shown being operated on by two 30-ton hammers. These are served by a crane of 100 tons capacity. In the steel foundry, where steel castings of all kinds up to 38 tons weight are made, and which is served by two travelling cranes of 30 tons and one of 25 tons, the casting of heavy gearing, &c., from the 10-ton Siemens furnace was shown under way. Here also was proceeding the moulding of a rudder frame of 13 tons weight, a riveter hob of 13 tons, a hydraulic cylinder of 22 tons, and a press head of 14 tons for a large hydraulic press, one of four presses which the firm have on order. The firm's output of steel castings for locomotive, hydraulic, marine, and general engineering purposes, is upwards of 1500 tons per annum. In the dressing-shop work was in progress on one of the press heads alluded to, on cogging rolls, 42in. diameter and 18½ tons finished weight; on a large double-helical pinion, 12 tons finished weight, and on a riveter cylinder hob of about 10½ tons weight.

In the heavy machinery shop of the gun works operations were progressing on shafting for battleships and armoured cruisers, including shafts for H.M.S. Irresistible and Cressy, and two propeller shafts 74ft. long, 18 tons each, for a foreign cruiser; two other propeller shafts exactly similar are also on order.

In the crucible department, besides work on miscellaneous ingots, the casting of an 18in. ingot of about two tons weight for punch and die steel was proceeding. The annual output of Firth's crucible steel is from 5000 to 6000 tons, this being chiefly used for general engineering work in its varied branches, and especially for turning tools, twist drills, reamers, punches, dies, hammers, axes, &c. Mining supplies in the way of gearing, tools, &c., are a speciality, as are also files, saws, and edge tools of all kinds. The firm, indeed, from their position and experience can turn out anything that may be required in the finest crucible steel, heavy or light. Up to the year 1880, when crucible steel was still used for heavy ordnance, shafting, cranks, tires, &c., single ingots were cast up to 30 tons in weight, and at the same time pieces were being turned out of every size from wire for needles up to tubes for the 110-ton gun. The ingot required for the pieces going to form the celebrated "Woolwich Infant" required about 1000 crucibles. A necessary and very special feature in the manufacture of modern ordnance of Siemens-Martin steel is the hardening process, and for this the firm have an oil hardening tank 75ft. deep and 15,000 gallons capacity, into which the tubes for the heavy guns are submerged, served by a 50-ton swing crane.

Another notable speciality of the firm is the manufacture of armour-piercing and cast steel shell. At the works are seen shell from 6in. to 13½in. calibre, some of which are still practically undamaged after passing the firing test against compound armour. Shot and shell were, on the occasion of the visit, to be seen in all stages of manufacture, including armour-piercing shot, forged steel high-explosive shell, and cast steel shell of various sizes.

Of the visits paid to the Clyde Steelworks of Messrs. Samuel Osborn and Co., and the Dannemora Steelworks of Messrs. Sabohm and Dieckstahl, we are compelled to reserve notice meantime.

To all the members of the party alike the visit to the cutlery works of Messrs. Joseph Rodgers and Sons proved most interesting. They were conducted through the various cutlery departments, ivory cellars, and the handsome show-rooms, in the latter of which many objects arrested attention, including the celebrated "Norfolk" knife containing seventy-five blades, probably the most perfect, complicated, and costly example of cutlery manufacture ever produced. Its length with the blades open is about 20in., the handle of mother-of-pearl being elaborately carved with hunting scenes. On the larger blades are hand etchings representing notable English residences, the designs for which are amongst the most perfect ever worked on steel. This knife was specially manufactured for the great Exhibition of 1851, and was last shown at Paris in 1878, when it was awarded a gold medal; but it is now regarded as too valuable to risk injury in transport. Another interesting item is a knife commenced in the year 1822, fitted with a blade for each year, and since then at the end of every five years additional blades have been added, the last time in 1895 bringing the total number equal to that date. In the show-rooms also were seen many interesting curiosities. For example, scissors 24in. in length were strikingly contrasted with microscopically minute specimens of scissors and razors, a dozen of which on one side of a jeweller's balance fail to turn the beam against a half-grain weight. About 2000 hands are employed in the various departments of the central and subsidiary works, and some idea of the magnitude of the business done may be gathered from the fact that the weekly output of manufactured goods is equal to 60,000 table knives and forks, 3000 carving knives and forks, 18,000 spring knives, some 15,000 razors, and an equal number of scissors.

When the several parties had returned to the Cutlers' Hall, luncheon was again partaken of at the invitation of the

Reception Committee, and the afternoon was devoted to an excursion to Welbeck Abbey, the seat of the Duke of Portland, with its remarkable underground roadways and passages, and famous Portland collection of miniature paintings and manuscripts. In the evening Alderman Franklin, the Lord Mayor, and the Lady Mayoress held a reception in the Town Hall in honour of the visit of the Institution to Sheffield, for which about 1000 invitations had been issued. The whole of Friday was devoted to an excursion to Haddon Hall, that finest of old baronial mansions, which so largely figures in history and romance, and to Chatsworth, the celebrated seat of the Duke of Devonshire, and repository of exquisite works of art and *vertu*. The outing was most thoroughly enjoyed, the visitors being charmed with the inspection of Haddon Hall, and the beauties of Chatsworth House and gardens. Dinner was eaten at the Baslow Hydropathic, and here, as at other functions, toasts and votes of thanks were proposed and honoured with spontaneity and enthusiasm. The visitors returned to Scotland on Saturday forenoon greatly delighted with their visit to Sheffield.

## THE AMALGAMATED SOCIETY OF ENGINEERS.

THE publication of the annual report of the Amalgamated Society of Engineers has been anticipated by employers in the engineering trade with some curiosity, and by members of the above important organisation, which had to bear the brunt of the late disastrous dispute, with, no doubt, anxious misgivings as to the position in which the Society had emerged from the conflict. That the annual report, which has only been issued during the past week, should this year be later than usual in making its appearance is, under the circumstances, scarcely surprising. The task of tabulating and balancing up the almost indefinitely multifarious items of expenditure and income in connection with so prolonged and so widespread a struggle must have been enormous, and it would perhaps be too much to expect an absolutely accurate record of all the outgoings involved in the strike, or of all the money raised in one way or another to carry on the contest. In fact, with regard to the amounts raised outside the Society's ordinary sources of revenue, the report is somewhat indefinite. The stated period to which the report is made up—the last meeting in December, 1897—is, considering the enormous outgoings of the Society at the time, also scarcely sufficiently exact; whilst a further important consideration is that the report does not cover the whole period of the strike, as it was not until the last day in January, 1898, that work was resumed. There is consequently at least a further five weeks of the heaviest expenditure in connection with the strike which is not included in the report, whilst for the succeeding four months, and, in fact, up to the present time, the number of unemployed members on the books of the Society as the direct result of the strike, although steadily diminishing, has been very largely in excess of the average.

These are considerations which must necessarily be taken into account in briefly summarising the statements contained in the annual report of the Amalgamated Society of Engineers that has now been sent out to the members, and until Mr. G. N. Barnes, the general secretary, issues the supplementary report which he promises, and which is to cover more completely the various financial operations connected with the strike, the present report can only be regarded as partially setting forth the position in which the Society has been placed as a direct result of the seven months' struggle. Mr. Barnes, in his introductory address to the annual report, very truly remarks that the period passed under review had been one of great stress and trial. The lock-out of last year would yet, however, have far-reaching consequences, and he ventured to think that already many illusions on both sides had been dispelled. The lessons derivable were clear and unmistakeable, and an immense impetus would be found to have been given to the widening out of industrial organisation and supervision. "Already," Mr. Barnes continues, "and partly as a result of the lock-out, the federation of the unions has been brought within the sphere of practical discussion, and stimulus has been given to co-operative enterprise on its productive side, whereby the forces of trade unionism and co-operation are being brought together. In the larger sphere of collective supervision there can be doubt that the impression made on the public mind by the suffering, loss, and dislocation consequent upon the lock-out, will yet find due expression. True, the intervention of the Board of Trade last year was denounced by Sir Henry Howarth as an 'impertinence,' and by the *Times* newspaper as an 'unnecessary interference,' but reforms generally come this way. They are denounced by reactionary newspapers and by politicians, the latter often enough said to be men of science, until the public mind is familiarised therewith, and by others enlightened thereupon. For our part, we believe that the rights and duties of the community in this matter involve the sifting of and adjudicating upon the facts, and we believe that this principle is bound to be accepted here as soon as it is as well understood as in New Zealand."

Turning next to the items and figures in the report bearing directly on the operations of the Society during the year, Mr. Barnes, in the first place, points out that there had been a gross increase in membership of 12,105, and a net increase of 4589, the difference being the number of deaths and exclusions; or, in other words, they started the year with 87,455 members, and ended it with 91,444. With regard to the exclusions referred to by the general secretary, it may perhaps be interesting to mention that during the progress of the recent strike there were current rumours of very considerable defections in the Oldham district, which, however, at the time were strenuously denied. In the annual report just issued, some confirmation of these rumours is afforded in the list of members given who up to the close of last year had been excluded for "acting contrary to the Society's interests," which may be taken as meaning that they had practically seceded from the organisation. In this list the names of not less than 130 members are given who had been thus excluded in the Oldham and Hollinwood district, which practically embraces the centre, and it may be taken as almost certain that during the succeeding five weeks over which the struggle was protracted, there would be a very considerable increase in the number of members in the above district who from similar causes would be struck off the books. The figures relating to financial operations, Mr. Barnes proceeds, had assumed colossal proportions for a workmen's organisation, the income for the year amounting to £559,368, which, added to a balance of £305,882, from 1896, brought the total to £865,251, which was accounted for by an expenditure of £690,399, and a balance at the end of 1897 of £174,852. Included in the latter, however, was £20,000 excess of moneys borrowed over those lent, so that the total assets of the Society in December last amounted to about £154,000, exclusive of arrears. "This would come as a revelation to many who at the time in question were indulging in pessimistic twaddle about the effacement of the Society, and especially so to the journalistic Jeremiahs who augured from the capitulation of January last the utter rout and demoralisation of trade unionism as a force in industrial progress. They were then charged—and, singularly enough, many old friends, such as Professor Beesley, Frederick Harrison, and Morrison Davison, joined in the chorus—with having squandered in a single year the accumulations of forty-five years of patient industry, and at the same time invidious comparisons were drawn as between Newton and Allan, and those who were now to the best of their ability voicing the wants and aspirations of the Society's members. In regard to these statements he need only remind the faint-hearted that the "accumulations" in hand at this time last year were not of forty-five years, but that nearly one-half had accumulated since the beginning of the year 1896, and, further, that the "accumulations" in hand to-day were nearly equal to those of three years ago, lock-out notwithstanding." We may, however, here observe that some qualification is necessary with regard to this £154,000, which Mr. Barnes sets forth as the total assets of the Society at the close of the year, and point out that this sum includes £69,577 definitely set aside as a special superannuation reserve fund, so that the general and what is practically the really available fund of the organisation amounted, roughly, at the close of the year to not more than £84,500, as against £254,156 the previous year, or a reduction of about £170,000, and that it then stood before even the close of the strike at, in fact, the lowest figure the general fund has touched for the last twenty-six years; whilst a further comparison shows that the value per member of the Society at the close of last year, as given in the report, at £1 2s. 10½d., is with one exception by far the lowest recorded since the formation of the Society in 1851, the only occasion when it fell below this figure being in 1852, immediately after the great lock-out.

Dealing next with the details as to income, Mr. Barnes points out that they found that the contributions from members amounted to £448,936, or about 25 per cent. more than the highest previous total, whilst they had received £77,765 in voluntary contributions, a very large amount of which came from Germany, and a larger from the trade unions of this country. It should, however, be observed that a considerable amount came as voluntary contributions from their own branches, so that the contributions of their own members last year could not have fallen far short of half a million sterling. It should also be remembered that this was by no means a complete return of voluntary help rendered them in the late dispute, inasmuch as the Joint Committees in the various districts had considerable amounts sent to them. They would, however, issue a report later on, of a comprehensive character, in which they would show the whole of these voluntary contributions, as well as the disposition of the moneys so contributed. With regard to an item of £22,900, which figures in the report as the amount borrowed at the end of the year, Mr. Barnes, in reply to the natural inquiry which he admits might arise in the minds of readers as to the necessity for borrowing, refers to the fact of nearly half of their funds being locked up, and the difficulty of collecting the branch and other balances, and concentrating upon the lock-out areas. It was, he adds, the desire of the Executive to transfer the moneys of the Society to municipal stock and house property as much as possible, so that they might get therefrom the larger interest accruing, and at the same time assist those members who were desirous of doing so, to acquire possession of a house. They had investments of this character at the end of 1897 amounting to £77,296, as against £50,200 at the end of 1896, or an increase—spite of lock-out—of £27,096. These investments, it need scarcely be added, were made in the early part of the year, but for which they should have had no occasion to borrow.

On the expenditure side, donation and contingent disbursements were, of course, the largest, amounting to £281,177 and £129,077 respectively. Nearly allied to these, however, came those under the heading of emergency fund and local levy grants, which amounted in the aggregate to £113,677, or althogether, under these four headings, a total of £523,932. Deducting £100,000, which in round figures might be said to represent normal expenditure, the remainder was cost consequent upon the lock-out. Sick benefit showed a slight decrease, from £44,667 to £42,407, due no doubt to the larger number of men compulsorily idle. The superannuation benefit payments, however, had increased from £63,747 to £68,760. Funerals had cost £12,735, as against £12,799 the previous year, and benevolent grants £2134, as against £2663. It was satisfactory to note the fact that there had not been the slightest intromission in regard to any of the benefits of a character other than those connected with the dispute, during which they always had clearly in mind the interests of their old members as well as those stricken down by sickness or exceptional misfortune. The amount expended in the ways above enumerated reached a total of £654,728, the remainder of the expenditure being under the heading of management, and amounting to £35,670.

"Such," Mr. Barnes concludes, "is, in brief, the record of the most momentous year in the Society's history. It has been a year in which your fidelity has been put to a severe test, and you have not been found wanting. We have suffered a severe reverse, it is true, and spent a great deal of money; but such reverse came in a justifiable and well-sustained effort to make the conditions of London life more tolerable for labour. We believe now, just as much as last year, in the justice of the claim made, and therefore we believe that the abridgment of the working day for which the Society struggled is not lost, but only deferred for a time. Finally, we are convinced that the cause of labour will be advanced by what has taken place. The need for combination has been made more manifest; the essential solidarity of labour has been demonstrated; the line of progress more clearly defined, and, incidentally, the superiority of amalgamation, as compared with sectionalism in the engineering trade, has been made so plain that he who runs may read; for the Amalgamated Society of Engineers had to assume control and financial responsibility for the whole movement, and remains to-day intact, with the spirits of its members unbroken."

OF 208,975 tons of iron ore shipped from the island of Elba during 1897, 145,835 tons were for this country and 59,942 tons for Germany.

## THE COAL STRIKE.

THE action of the Provisional Committee has been to prompt the non-associated collieries to get a substantial advance in wages, and thus aid the strike fund. This, and the despatch of agents to all parts of the country, has been the work of the week.

On Saturday the Cambrian Collieries conceded an additional advance of 10 per cent. to their men. This makes 20 per cent. additional advance on the scale in operation at that colliery, which is the scale of 1877, and 15 per cent. above the scale of 1879. The deputation which obtained this concession informed Mr. D. A. Thomas, M.P., that they intend proposing that the whole of the 20 per cent. shall be devoted to the central relief fund of the strikers. This will mean a contribution of £1000 to £1250 per week.

Following this came the announcement of an advance of 10 per cent. at Tynewydd Colliery, Treherbert, and at Abergavenny, an important Rhondda colliery, and also one of the non-associated.

On Monday important meetings were held in Cardiff, the result of which is regarded as tending to materially increase the funds of the strikers, and thus conducing considerably to the prolongation of the dispute. Mr. Abraham, M.P., occupied the chair, and Mr. D. Morgan the vice-chair. The result of the roll call was to show that nearly 30,000 colliers were represented.

It was reported that forty-nine collieries were working on 32½ per cent. over and above the standard of 1879, and that twenty-four were working on 22½ per cent. only on the same standard, but that as regards the latter there would be an addition probably during the present week. It was suggested by several members that the necessary steps should be taken at all collieries where the advances had not been made to terminate contracts, Mr. D. Morgan intimating that "something strong should be done;" but, as it was shown that collieries differed materially in their arrangements the proposition of the chairman was carried, that the Provisional Committee should investigate all cases where the advance had been refused, and take proceedings to deal with the same effectually.

The next business was the amount of subscription sent by each colliery to the central fund, and the adoption of measures in relation thereto, the chairman commending the conduct of those, like the Cambrian men, "who had set such an example of practical aid in helping to fight for their rights." The concluding discussion was in reference to the Workmen's Compensation Act, and it was resolved that workmen be asked not to commit themselves respecting it until the meeting called for July 4th.

An important meeting of the enginemen and stokers of the several collieries was held on Monday at Cardiff to decide upon their course of action. After a long discussion it was agreed to adjourn the meeting to the 30th inst., when the Monmouthshire and South Wales Society of enginemen and stokers will hold their gathering in Cardiff, and it was hoped that all the members would be well represented.

Mr. Keir Hardie has addressed several meetings of colliers in Wales, and at one, held in Troedyrhiw on Saturday last, commented at length upon the situation, and spoke in the highest terms upon the conduct of the men throughout. In the course of his observations he censured "Mabon" for the attitude taken in suggesting a compromise, and thought they, the colliers, were sufficiently powerful to be represented by a man who would strenuously contend for a 10 per cent. advance and no sliding scale. At another meeting he considered that the leaders were responsible for continuing the strike.

The latest feature in connection with the strike has been action taken by the Working Men's Committee on Tuesday. The result of their deliberations was to send a deputation to London to wait upon Mr. Ritchie, appealing to him, it is understood, to intervene. The deputation saw Mr. Ritchie, and an early reply was promised.

Amongst the strike contributions of the week, £50 has been received from Welshmen in South Africa; the London Society of Compositors, £100; Nottingham Labour Society, £1 12s.; Co-operative Wholesale Society employés, £1 13s. 6d.; Wheelwrights and Smiths, Nottingham, £1. The great mass of subscriptions sent in are small, and, with few exceptions, confined to Wales.

## THE SANITARY INSTITUTE.

THE preliminary programme of the sixteenth congress, to be held in Birmingham, from September 27th to October 1st, has now been issued. The president of the congress is Sir Joseph Fayrer, Bart., K.C.S.I., M.D., F.R.C.P., F.R.C.S., LL.D., Q.H.P., F.R.S. Dr. Christopher Childs, M.A., D.P.H., will deliver the lecture to the congress, and Dr. Alex. Hill, M.A., J.P., Master of Downing College and Vice-Chancellor of Cambridge University, will deliver the popular lecture. Excursions to places of interest in connection with sanitation will be arranged for those attending the congress. A conversazione will be given by the Right Hon. the Lord Mayor—Councillor C. G. Beale—and a garden party at the Botanical Gardens, Edgbaston, will be given by members of the Sanitary Committee.

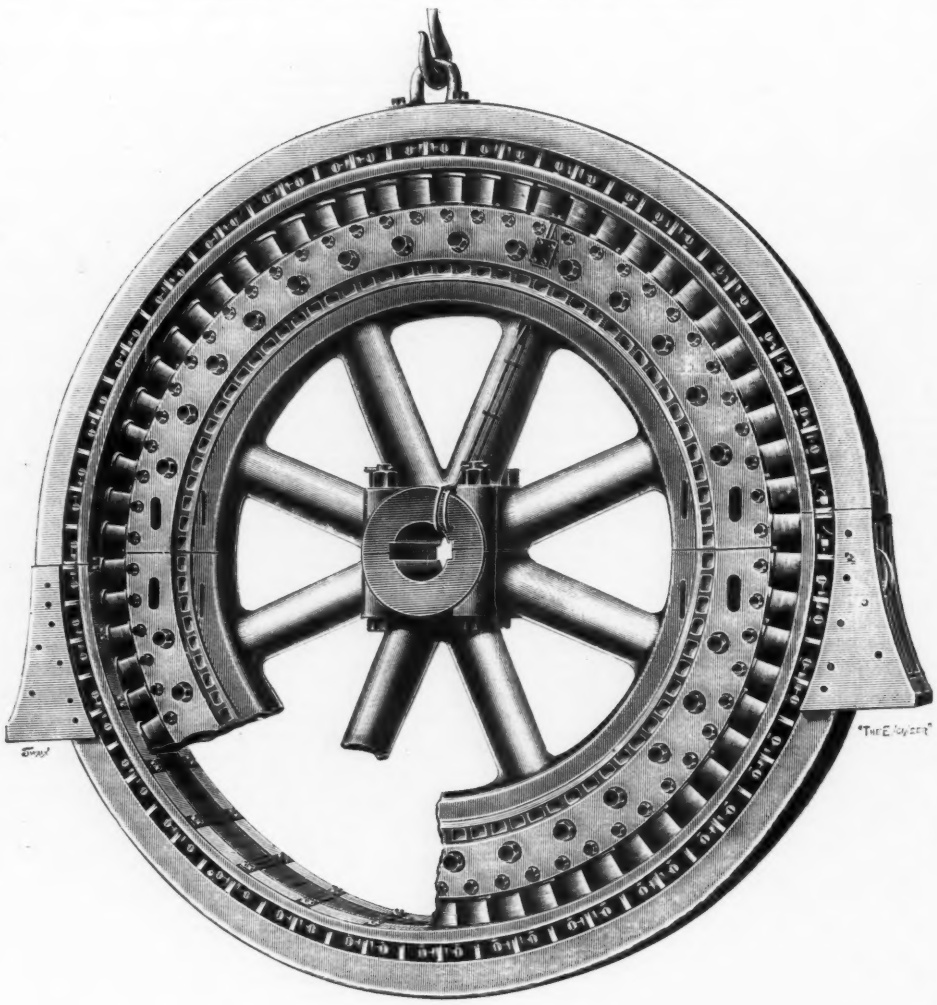
It appears from the programme that over 300 authorities, including several County Councils, have already appointed delegates to the congress, and, as there are also over 2000 members and associates in the Institute, there will probably be a large attendance in addition to the local members of the congress. In connection with the congress, a health exhibition of apparatus and appliances relating to health and domestic use will be held as a practical illustration of the application and carrying out of the principles and methods discussed at the meetings; which not only serves this purpose but also an important one in diffusing sanitary knowledge among a large class who do not attend the other meetings of the congress.

The congress will include three general addresses and lectures. Three sections meeting for two days each, dealing with (1) Sanitary Science and Preventive Medicine, presided over by Alfred Hill, M.D., F.R.S. (Edin.), F.I.C., M.O.H., Birmingham; (2) Engineering and Architecture, presided over by W. Henman, F.R.I.B.A.; (3) Physics, Chemistry, and Biology, presided over by G. Sims Woodhead, M.D., F.R.C.P., F.R.S. (Edin.). Five special conferences:—Municipal Representatives, presided over by Alderman W. Cook, Chairman of the Health Committee, Birmingham City Council; Medical Officers of Health, presided over by John C. McVail, M.D., D.P.H., F.R.S. (Edin.); Municipal and County Engineers, presided over by T. de Courcy Meade, M. Inst. C.E.; Sanitary Inspectors, presided over by W. W. West, Chief Sanitary Inspector, Walthamstow; Domestic Hygiene, presided over by Mrs. C. G. Beale—the Lady Mayoress.

The local arrangements are in the hands of an influential Local Committee, presided over by the Right Hon. the Lord Mayor of Birmingham, with Professor A. Bostock Hill, M.D., D.P.H., W. Bayley Marshall, M. Inst. C.E., J.E. Willcox, Assoc. M. Inst. C.E., as honorary secretaries.

## 300-KILOWATT HALL ALTERNATOR

MESSRS. JOHN FOWLER AND CO., LIMITED, LEEDS, ENGINEERS



### GENERATING PLANT AT MADRID.

In our impressions for October 18th and December 27th, 1895, we fully illustrated the generating plant at the Great Northern Railway Company's Electric Light Works, Holloway, made by Messrs. John Fowler and Co., and gave to our readers particulars of the last engine put down there by them fitted with Marshall and Wigram's positive Corliss gear. We now have pleasure in showing the same arrangement applied to four sets of vertical engines of 500 indicated horse-power non-condensing. The last two sets put down are exactly similar to our illustration, page 9, but the first two sets, which have been working nearly three years, have the dynamos coupled to the end of the crank shaft on the low-pressure side, and the details, of course, are somewhat altered to suit this arrangement, but the action of the valve gear is precisely the same; the governors, however, are driven by chain gear instead of gearing as in our illustration.

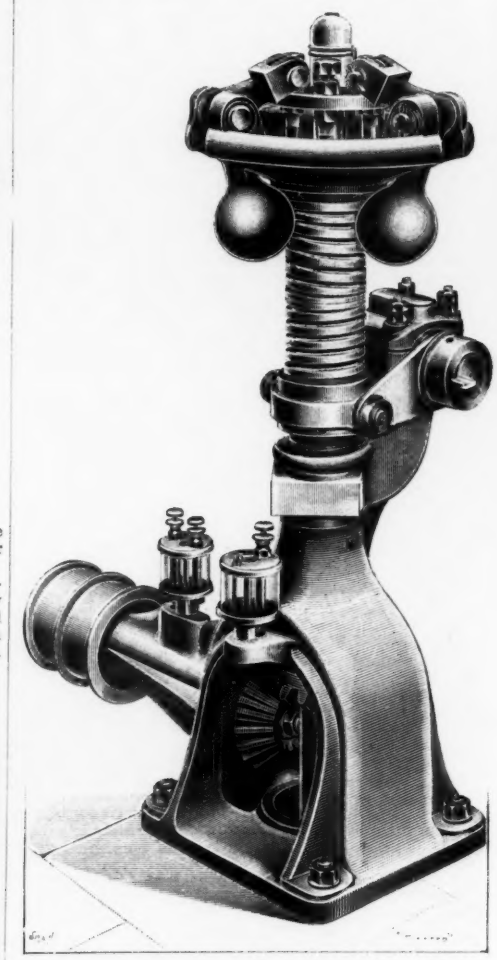
The cylinders are 20in. and 36in. by 21in. stroke, 156 revolutions, boiler pressure 125 lb., and are bolted upon very massive pillars, and connected together by a substantial casting, the exhaust steam passing over the top through an independent pipe from the high to the low-pressure cylinders. This arrangement prevents the cylinders from being pushed out of plumb, and makes a thoroughly substantial job.

The cylinders are thoroughly steam jacketed, and are fitted with separate liners, the Corliss valves being fitted in the end covers, thus giving the smallest possible clearance for steam. The action of the valve gear can be best judged by the indicator diagrams which we give on page 9—one set was taken with about 600 indicated horse-power load. We also show diagrams taken from a compound-condensing engine made by Messrs. John Fowler and Co., with the same size gear when working light without any load. This shows the good cut off that is got by the gear, whether light or loaded, condensing or non-condensing. The automatic positive gear is controlled by a vertical governor, which has given good results, and which we have referred to before upon former occasions. We illustrate below Marshall's governor. These governors have been fitted to the steam alternators just recently completed for the Corporation Electricity Works, Wakefield, by Messrs Fowler and Co.

On November 14th of last year trials were run with one of the last plants put down for testing its efficiency; the consumption of water per kilowatt hour amounted to 33·4 lb., the net indicated horse-power being about 490, showing a combined efficiency of 82 per cent. On February 17th of this year a five-hours' test was carried out by Mr. H. M. Sayers, the engineer and manager, upon one of the first plants of this type put down. The results we now give as follows:—

| | |
|---|---|
| Steam in boilers, 150 lb. reduced down to steam chests | 125 |
| Total quantity of water fed into boilers | 25,819 kilos.—56,924 lb. |
| Total water condensed from separators on steam pipes and high-pressure chest | 6786 lb. |
| Net water consumption | 50,138 lb. |
| Mean kilowatts | 297 |
| Voltage | 2000 |
| Water, per kilowatt hour | 33·7 |
| Coal, per kilowatt hour | 5·79 lb. |
| Coal, bituminous nuts (Spanish) | 54 per-cent. fixed carbon |
| Volatile matter | 34·8 per cent. |
| Ashes | 10·8 per cent. |
| Evaporation | 6·62 lb. per 1 lb. coal |
| Boiler efficiency | 61·8 per cent. |

The whole plant ran perfectly cool, and free from any trouble from start to finish.



MARSHALL'S GOVERNOR

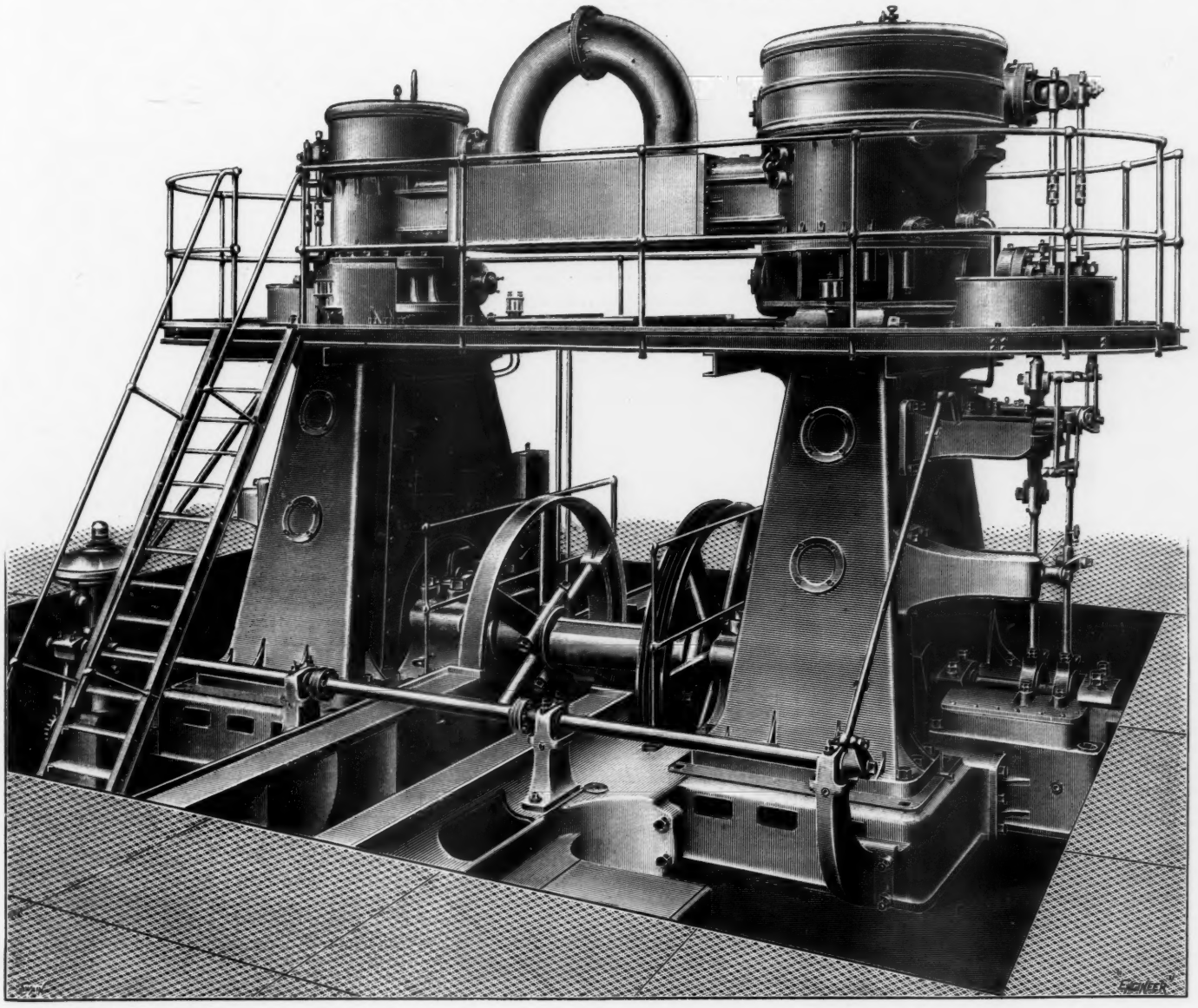
MARSHALL'S PISTON

There are four 300-kilowatt Hall alternators, driven direct by four 500-horse power vertical engines. Each of the alternators is constructed to give its full output at a speed of 156 revolutions per minute, with a periodicity of 83 per second. The field magnets of the alternators form the fly-wheel of the engine, and in two cases are placed between the high and low-pressure cylinders of the engines, the foundation plate of which is arranged to take the alternator armature, which is slot or polar wound. The other two alternators are driven from the end of the engine shafts. The alternators have a very high insulating resistance, the coils being insulated with mica, and have resisted a piercing spark of 4000 volts, the ordinary working pressure being 2000. Both the field magnets which form the fly-wheel, and the armature which surrounds the same, are extremely massive in construction, and are consequently capable of withstanding severe strains and variations of load which they are constantly put to.

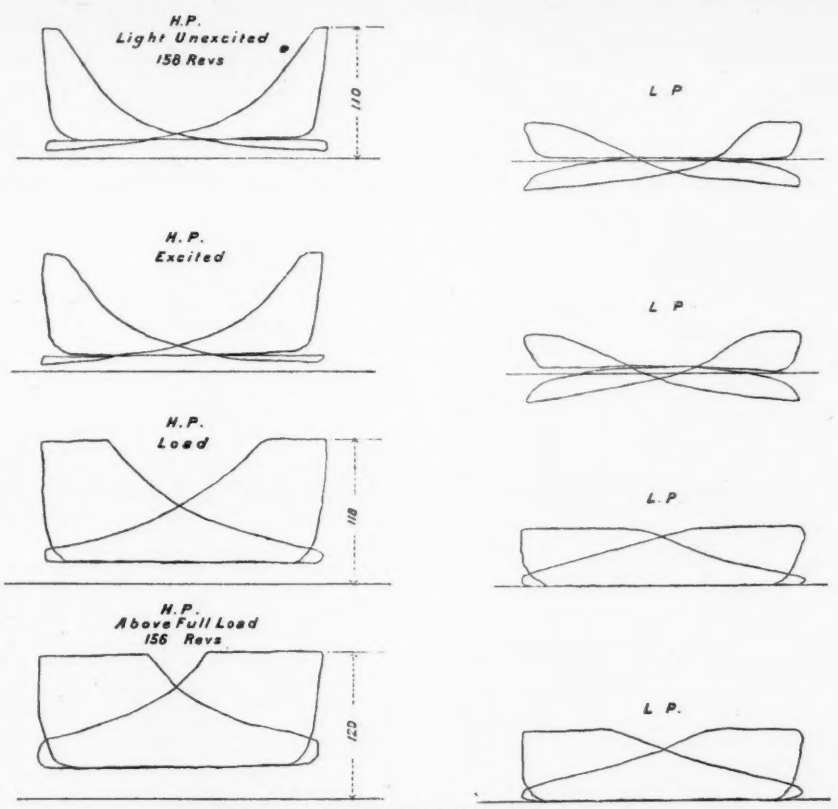
It is customary to run these four plants in parallel on the mains, and this they do perfectly satisfactorily without the intervention of spring couplings or any other device. It is found that with this particular type of alternator there is sufficient elasticity in the steam in the cylinders readily to take up any of the electrical balancing necessary in parallel running. The armatures are so constructed that they can readily be opened out for cleaning and inspection, which is accomplished by means of a screw rack and gear, which draws the armature apart on the planed face of the bed. The field magnets which form the fly-wheel are built up of charcoal iron and have sixty-four poles. The armature core is also built up of charcoal iron, but has only thirty-two armature coils. These are so constructed that in the event of one being damaged it can be replaced by a new one in the space of a few minutes.

# COMPOUND ENGINES, MADRID ELECTRICITY WORKS

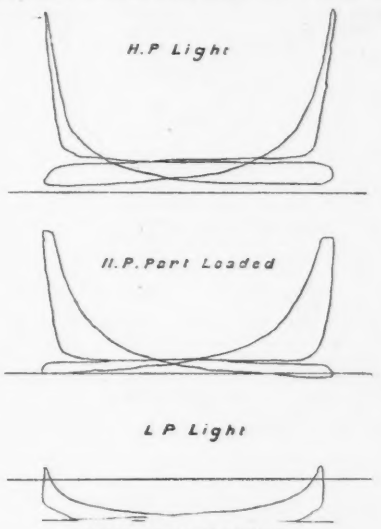
MESSRS J. FOWLER AND CO., LIMITED, LEEDS, ENGINEERS



The arrangement of the governor is the outcome of considerable experience with an earlier form, and the experience gained, especially with engines when running in a parallel for electric light work, has been satisfactory. It will be seen that the governor springs are preferably made in two lengths with right and left-hand coils, and are fitted on the outside of the vertical stalk which is attached to the governor head. On the underside of this head a plate is held in position by screw pins, which take the push of the top side of the springs when the governor stalk or sleeve is lifted. The screw pins being secured in the top plate or crosshead by locknuts, this plate is fixed to the governor spindle and revolves with it. The top side of this plate receives the full power of the governor balls through friction rollers which are attached to the lever arms resting upon it, a steel plate being let in to reduce the friction to a minimum; by this arrangement the governor head is free to lift up or down by allowing the screw pins to pass through to suitable holes in the governor head. This governor has been adopted by Messrs. Fowler for all their engines, and we may mention that the steam alternators recently made and fixed by them for the Wakefield Corporation Electricity Works are fitted with these governors.




MARSHALL AND WIGRAM'S VALVE GEAR—DIAGRAMS




VALVE GEAR—DIAGRAMS

We also illustrate the piston. The principle is that the piston ring has a corrugated spring behind it, the corrugations being caused by internal bosses in and out of which the spring is wound, the effect of which is that the flat portion of the spring bearing on the piston ring is always at a sustained, definite, and constant tension, thus causing the ring which it

supports to keep the cylinder uniformly steam-tight. In addition to the spring just described spiral springs are arranged enclosed in hollow bosses of one of the rings, so as to bear firmly on the blank boss of the neighbouring ring, by means of which a spring bearing is obtained in both directions, viz., lengthways and across the barrel of the cylinder, each being independent of the other. This arrangement has been found in practice, we understand, to reduce greatly the friction of the rings upon the cylinder walls quite 50 per cent., and it also enables the extra vertical pressure upon the rings to be sustained without interfering with the free action of the rings to keep steam-tight.

## CITY OF WAKEFIELD ELECTRICITY WORKS.

THE Corporation Electricity Works at Calder Vale, which were formally opened on Wednesday, June 15th, for the public supply of electricity, have been laid down under the powers accorded to the Corporation by their Electric Lighting Provisional Order, granted in the year 1894. Soon after this order had been confirmed by Parliament the Corporation appointed Mr. Robert Hammond, M.I.E.E., of Westminster, as their consulting electrical engineer, and having had under consideration his report upon the prospects of electricity supply in the city, they decided to take steps to carry their powers into effect. Mr. Hammond was instructed to prepare plans and specification of the works, and in July, 1895, tenders were invited. Eventually, the contracts were placed in the hands of Messrs. John Fowler and Co., Limited, Leeds, for the boilers, engines, alternators, and switch gear; the British Insulated Wire Company, Limited, of Prescot, for the underground mains; and the Brush Electrical Engineering Company, Limited, for the arc lamps. The buildings comprise boiler-house, engine-house, testing-room, workshop, stores, and offices. The boiler-house contains two large Lancashire boilers, built by Messrs. Spurr, Inman, and Co., of Wakefield, each capable of evaporating 7000 lb. of water per hour at 125 lb. pressure. They are fitted with mechanical stokers. In the engine-house there have been erected two slow-speed steam alternators, made by Messrs. John Fowler and Co., Limited, Leeds, each of 130 kilowatts —about 4000 8-candle power lamps—maximum capacity, while a further set of similar sized plant is now in the makers' shops, and will be erected in due course. The engines are of the horizontal compound type, with the alternator built up on the fly-wheel. For the day load business a small set of high-speed Bellis-Fowler plant has been provided. By the aid of this plant the larger plant can be shut down during the period when the demand for electricity is small. The workshop is equipped with the tools necessary for handling repairs to the machinery.

All the switching apparatus has been fixed in a switch gallery in the engine-house, the main board being designed on the Lowrie Hall system of plug switches. The switch-board is divided into three parts, the centre portion dealing with the synchronising instruments, the left-hand portion with the distributing circuits, and the right-hand with the alternators. The signalling apparatus for communicating to the engine drivers from the switch-room is controlled electrically. The apparatus consists of two cast iron boxes with ground-glass fronts arranged in separate compartments, each divided off from one another, and each being fitted with a lamp behind the ground glass. One of the boxes has its divisions marked with the numbers of the engine, the numbers being painted on the ground-glass referred to; the other box has the driver's instructions painted on the ground glass, one word for each division, viz., "fast," "slow," "right," "stop." When the signal is desired to be given an electric bell is sounded, the attendant closes a switch belonging to the particular engine for which the signal is intended; this lights up the lamp immediately over the switch, and also the lamp in the particular compartment of the indicator whose glass front bears the engine number. He also closes the switch belonging to the particular word of instructions in the other box, and the lamp lights up in the same manner. The driver in the engine-room has therefore two illuminated signals, the one giving him the number of the engine which he is to operate, and the other instructing him to go either "fast," "slow," or to "stop." A testing-room is fitted with all the necessary instruments.

The distribution of electrical energy to all parts of the city is effected from one central point at the top of Westgate, where a large underground chamber has been built. Three high-pressure trunk mains connect this chamber with the generating works, and are here connected to the three large transformers, which reduce the pressure from 2000 to 200 volts for distribution to the surrounding streets. Branch high-tension mains are also taken from this sub-station to a few outlying transformers. The Ings-road Schools and the County Buildings have already been dealt with in this way, and it is proposed to adopt a similar method for the St. John's district. The mains throughout for both high and low-pressure are of the concentric pattern, with paper insulation between the conductors. The high-pressure mains are everywhere drawn into stonewhere culverts, but the low-pressure are lead covered and armoured with steel tapes and laid directly in the ground. Spare ways have been provided in the culverts to permit of the drawing in of additional high-pressure mains in the future without disturbing the surface of the pavements. A special telephone wire connects the works to the Westgate sub-station.

The total capital expenditure to date is £25,000, and the tradesmen express themselves in terms of high appreciation of the new illuminant. A beginning is shortly to be made with public lighting by means of nine arc lights. The works are constructed in conjunction with a dust destructor, erected by Messrs. Manlove, Alliott, and Co., Limited, so that the steam for the day service will cost nothing.

THE MANUFACTURE OF BICYCLE FRAMES.—A new means of making the joints of bicycle frames without brazing is being exploited by the Metal Tube Jointing Company, Limited, of 11 and 12, Walbrook, London, E.C. It consists, briefly, in forming a roughened surface on the inside of the female part of the joint by means of a kind of milling tool, and then expanding the end of the tube to be inserted by means of special machinery, so that the sharp edges on the female part are embedded in the outer surface of the tube, somewhat after the manner of the system of the so-called hydraulic welding, of which so much has recently been heard. The jointing is effected by special machines having expanding rollers, and the whole of the joints of a bicycle frame can be made in a short space of time. An advantage claimed for this system of manufacture is that the outlay for plant is comparatively light, bringing it within the reach of small makers.

## FOUR DAYS' TESTS ON A SULZER TRIPLE STEAM PUMPING ENGINE.

Summary by BRYAN DONKIN, M.I.C.E.

THE following interesting set of tests made by Professor Stodola, of Zurich, on a new engine driving a pump direct, has lately been published in Germany. The water is taken from the Lake of Constance, and pumped to supply the town of St. Gallen, in Switzerland.

It will be seen that the results are very economical, and that a superheater and economiser are provided. The steam, at 150 lb., was dried but not superheated. The pounds of steam used per indicated horse-power per hour varied from 11½ lb. to 12 lb. at full speed, and only 12¾ lb. at half speed. The heat efficiency of the Cornish boiler was 81 to 82 per cent. The gases of combustion were carefully analysed. The indicated horse-power varied at full speed from 201 to 207, and at half speed it was 101. The water was pumped about 1115ft. high. All the chief results will be found in the following table. In the original papers full particulars are given, with drawings and indicator diagrams from all steam cylinders, and also pump. The quantity of water pumped, however, was not measured.

The dimensions of the steam engine were:—Diameter of high-pressure cylinder, 14$\frac{3}{16}$in.; diameter of intermediate cylinder, 23$\frac{5}{8}$in.; diameter of low-pressure cylinder, 34$\frac{7}{16}$in.; stroke, 39$\frac{3}{8}$in.; 6½in. diameter water pump at end of low-pressure cylinder, tandem same speed and stroke as pistons.

The boiler was of the Cornish type, set in brickwork, and economiser; gas coke as fuel, hand-stoking, chimney draught. The boiler was 29ft. long by 5ft. 1in. diameter, giving 753 square feet heating surface; economiser, 645 square feet heating surface; superheater, ditto.

The engine was of the horizontal condensing type, with two cranks; the cylinders and covers were steam jacketted.

*Boiler Results.*

| | | | | | |
|---|---|---|---|---|---|
| Dates of trial, 1897 | | 26th March | 27th March | 28th March | 29th March |
| Duration of trial, hours | | 8 | 6 | 9½ | 7½ |
| Speed of engine | | Ordinary | Half-speed | Ordinary | Ordinary |
| Kind of grate | | Ordinary | Ordinary | Ordinary | Küdlitz |
| Temperatures, deg. Fah. | Steam in steam pipe | 367 | 363 | 368 | 361 |
| | Gases before entering superheater | 440 | 358 | 444 | — |
| | Gases before entering economiser | 382 | 341 | 384 | 394 |
| | Gases after leaving economiser | 170 | 158 | 179 | 181 |
| | Feed-water before entering economiser | 47 | 48 | 47 | 47 |
| | Feed-water after passing through economiser | 131 | 129 | 126 | 134 |
| Steam pressure by gauge, pounds per square inch, and corresponding temperature, Fah. | lb. | 145 | 151 | 149 | 150 |
| | deg. | 363 | 366 | 365 | 366 |
| Chimney draught, inches of water | | $\frac{3}{10}$ | $\frac{1}{2}$ | $\frac{4}{5}$ | $\frac{3}{5}$ |
| Consumption of steam used by jets of the Küdlitz grate, lbs. per hour = 4½ per cent. of feed-water | | — | — | — | 106 |
| Ashes and clinkers in per cent. of gas coke burnt | | 10·1 | 6·8 | 8·1 | 8·8 |
| Thermal units per square foot heating surface p. m. transmitted through boiler plates only | | 58·5 | 33·1 | 61·0 | 61·7 |
| Water evaporated, pounds of water per pound of coke (gross evaporation) | | 9·43 | 9·28 | 9·17 | 5·78 |
| Water evaporated, pounds of water per pound of coke from and at 212 deg. Fah. | | 11·49 | 11·31 | 11·31 | 7·04 |
| Grate area, square feet | | 18·36 | 12·25 | 18·36 | 18·36 |
| Pounds of gas coke burnt per square foot grate per hour | | 14·1 | 12 | 14·8 | 29·6 |
| Pounds of water evaporated per square foot of heating surface per hour | | 3·21 | 1·81 | 3·33 | 3·26 |
| Heating value of the coke in thermal units per pound | | 12,692 | 12,206 | 12,305 | 9941 |
| Combined heat efficiency of steam boiler and economiser, or per cent. of heat value in fuel utilised in heating and evaporating water | | 86·91 | 88·14 | 87·06 | — |
| Loss by chimney, per cent. | | 4·91 | 4·56 | 5·70 | — |
| Other losses and unaccounted for, per cent. | | 8·18 | 7·30 | 7·24 | — |
| Total, per cent. | | 100·00 | 100·00 | 100·00 | — |
| Heat efficiency of the steam boiler only, per cent. | | 80·78 | 82·02 | 81·25 | — |
| Heat efficiency of the economiser only, per cent. | | 6·13 | 6·12 | 5·81 | — |
| Foot-pounds of water pumped per pound of coke | | 1,209,376 | 1,069,943 | 1,149,602 | 722,476 |
| Foot-pounds of water pumped per 1 British thermal unit in coke | | 95 | 87 | 93 | 72 |
| Analysis of gas at end of Cornish tube after one run, per cent. by vol. | $CO_2$ | 14·2 | 13·7 | 16·7 | 17·4 |
| | O | 6·1 | 7·0 | 3·5 | 1·4 |
| | CO | 0 | 0 | 0 | Traces |
| Analysis of gas at damper end of boiler, per cent. by vol. | $CO_2$ | — | — | 6·5 | 6·5 |
| | O | — | — | 14·1 | 13·1 |
| | CO | — | — | 0·0 | 0·0 |
| Per cent. air in excess at end of boiler tube | | 40 | 50 | 20 | 7 |
| Per cent. air in excess at damper, about (showing considerable leakage of air through brick work, &c.) | | — | — | 200 | 200 |

*Sulzer Triple Steam Engine Results.*

| | | | | | |
|---|---|---|---|---|---|
| Dates of trial, 1897 | | 26th March | 27th March | 28th March | 29th March |
| Revolutions per minute | | 60·44 | 30·6 half-speed | 60·13 | 60·13 |
| Indicated power developed by engine, indicated horse-power | | 207 | 101 | 205 | 201 |
| Indicated power absorbed by pump, indicated horse-power | | 168 | 83·6 | 166·9 | 167·2 |
| Difference, indicated horse-power | | 39 | 17·4 | 39·1 | 33·8 |
| Ratio of pump horse-power to indicated horse-power of engine, or mechanical efficiency of engine and pump, per cent. | | 80·9 | 82·7 | 81·1 | 83·0 |
| Volumetric efficiency of the pumps (assumed), water not measured, per cent. | | 95 | 95 | 95 | 95 |
| Pounds of steam used per indicated horse-power per hour | | 11·52 | 12·72 | 12·0 | 11·6 |
| Thermal units per indicated horse-power per minute | | 211 | 233 | 220 | 212 |
| Pounds of gas coke burnt per pump horse-power per hour | | 1·53 | 1·73 | 1·61 | 2·55 |
| Thermal efficiency of engine, per cent. | | 16·04 | 14·44 | 15·68 | 12·27 |
| Vacuum in the condenser, inches | | 25½ | 26 | 25½ | 25½ |
| Dryness fraction of steam at beginning of expansion, high-pressure cylinder, per cent. | | 77 | 65 | 77 | 77 steam |
| Dryness fraction of steam at beginning of expansion, intermediate cylinder, per cent. | | 25 | 33 | 26 | 25 water |
| | | 92 | 86 | 91 | 92 steam |
| Dryness fraction of steam at beginning of expansion, low-pressure cylinder, per cent. (*These do not always add up to 100 per cent.*) | | 8 | 13 | 9 | 8 water |
| | | 85 | 74 | 75 | 86 |
| | | 13 | 23 | 23 | 13 |
| Steam condensed in steam jackets of cylinders in per cent. of total consumption of steam | High-pressure cylinder | 4·33 | 10·54 | 3·67 | 4·38 |
| | Intermediate cylinder | 6·59 | 3·34 | 6·89 | 6·34 |
| | Low-pressure cylinder | 4·51 | 0·91 | 2·4 | 4·63 |
| Total, per cent. | | 15·43 | 14·79 | 12·96 | 15·35 |

Clearance, high-pressure cylinder, 5½ per cent; intermediate cylinder, 5 per cent.; low-pressure cylinder, 6 per cent.
Ratio of high-pressure cylinder to intermediate cylinder = 2·91 } cut-off 1/6
Ratio of intermediate cylinder to low-pressure cylinder = 2·13 } about.
The feed-water was also measured with steam engine running empty at 60½ revolutions per minute. Indicated horse-power = 38, including friction pump (but without water). Steam per indicated horse-power per hour = 18 lb.

## COLT'S NEW MACHINE GUN.

THE Colt's Fire-arms Company has, we learn from our American correspondent, brought out a new automatic machine gun, which can be mounted on a fixed stand or a field carriage, or carried in a long holster by cavalry, or mounted on a police patrol wagon. The gun weighs 40 lb., the tripod stand 54 lb. For naval service, the weight of a gun mounted on a wheeled carriage with ammunition, &c., is 230 lb., this design being intended for the use of landing parties. The gun consists of a heavy barrel attached to a casing which contains all the operating mechanism. Towards the muzzle end is a small vent, opening into the barrel, through which the confined gas from the explosion of the powder attempts to escape after the projectile has received its maximum velocity. In so doing the pressure acts upon a small piston which throws an operating lever, causing in turn suitable mechanism to eject the empty shell and place a new cartridge. Springs return the gas lever, which forces the cartridge into the barrel, closes and locks the breech block, and cocks the hammer ready to be fired again. If the gun is empty, as in starting, the gas lever is first thrown by hand. When once started, however, the action is entirely automatic, and the gun may be fired singly by pulling the trigger once or continuously by holding the trigger. In the latter case, between 400 and 500 shots can be fired per minute. The handle and trigger are similar to those of a revolver, but there is no guard below the trigger. The cartridges are mounted upon a canvas belt which is coiled up in a box hanging at the side of the gun, so that any movement of the barrel in aiming will not affect the feeding mechanism. The boxes are made in three sizes, containing 100, 250, and 500 cartridges respectively. The gun can be constructed for any kind of rifle ammunition, the standard calibre for the United States navy being 6 mm. or 0·236in. Three other standard calibres are also made, 0·7 mm., 0·765 mm. and 0·8 mm. In all cases smokeless powder is required to prevent clogging, and the collection of residue in the barrel is prevented by constructing the hammer to act as a piston for an air pump, which forces a jet of air through the barrel after the empty shell has been ejected. Nickel-jacketed bullets are used, to give the greatest possible penetration, and these give an effective range varying from 1960ft. to 2500ft. and a penetration of 48in. to 60in. of pine, according to the calibre. To avoid accidents when a loaded cartridge is left in the barrel, a safety lock is provided, which prevents the hammer from striking the firing pin. The working parts are few, simple, and strong, and are so designed that the main spring, firing pin, and other parts where there is any possibility of derangement can all be easily and rapidly removed from the rear of the gun without loosening a single screw. The barrel is made unusually heavy, to give weight, prevent injury, and obviate the necessity of using the usual water jacket.

NEW COUNTY SURVEYOR FOR MIDDLESEX.—Mr. Henry T. Wakelam, A.M. Inst. C.E., M.S.A., at present county surveyor of Hereford, has been appointed to a similar position by the Middlesex County Council, in place of Mr. Pownall, who is retiring from the service. The salary of the new county surveyor has been fixed at £700 a year, rising by annual increments to a maximum of £850. The question of paying Mr. Wakelam, in the case of the preparation of plans of new buildings and bridges, a commission of 2½ per cent. where the contract price exceeds £1000, was recommended by the Highways Committee of the County Council, but the latter has referred the matter back to the Committee.

STEAM GENERATION FROM REFUSE.—Two or three months ago the St. Pancras—London—Vestry were informed by the Electricity and Public Lighting Committee that the production of 437 electrical units had been traced as being due to the utilisation of the waste steam available at the refuse destructor, and it was suggested that in this direction the destructor might eventually become a source of profit to the parish. With this object in view the Vestry instructed Mr. Sydney F. Baynes, the chief electrical engineer, to make a series of tests as to the possibility of using the steam in connection with the generation of electricity. Since then a number of tests have been carried out, but in consequence of the irregularity in the supply of steam it has been found impossible to rely upon it for generating purposes, and hence the experiments have had to be abandoned. A possible explanation of the lack of a constant supply of steam may be found in the fact that in two parts of the parish the collection and disposal of the refuse are being carried out by contract, and in this manner several of the cells are deprived of fuel and cannot be worked. It is therefore probable that on the expiration of the contract in question the interesting tests inaugurated by the chief electrical engineer will be resumed.

## RAILWAY MATTERS.

LIEUT.-COLONEL J. L. WILKINSON, of the Engineer and Railway Volunteer Staff Corps, and general manager of the Great Western Railway, has been appointed a member of the Army Railway Council, in place of Lieut.-Colonel Sir Charles Scotter, resigned. Captain Girouard, director of the Soudan Railways, has been appointed to replace Mr. F. E. Robertson as president of the Egyptian Railways Administration.

RUSSIAN enterprise in the Far East is manifesting itself in connection with the new railway projects. The Tsung-li-Yamen having authorised the construction of a railway fifteen miles in length to the coalfields west of Pekin, and granted two million five hundred thousand taels for the purpose, M. Pavloff is urging the Chinese officials to employ Russian engineers, instead of Mr. Kinder's staff, to make the survey.

AN analysis of the main features of the working of the Madras Railway during the last ten half-years shows that the mileage open to traffic has during that period remained unaltered. Indeed, for the last quarter of a century, during which the mileage of railways in India has risen from 7000 to 21,000, this company has only increased its length by 15 miles, at the same time decreasing it by 30, thus, according to *Indian Engineering*, making a net decrease of 15 miles.

A TRAMWAY is at work in Denver, Colorado, which possesses a feature of novelty in passenger transport. The line is about a mile in length, and has a gradient averaging about 3½ per cent. Horses are employed to supply the tractive force on the up journey, and gravity supplies the means for returning the cars and passengers, the horse riding on the platform. The company owns one car and five horses, and the daily mileage is about forty. The horse is able to draw the car up the grade at an average speed of about 2½ miles per hour, and the car descends by gravity at a rate of about 15 miles per hour.

IT is stated on good authority in Pekin that a hitch has occurred in the negotiations regarding the Pekin-Hankau Railway, owing to the Chinese refusing to agree to the Belgian demands. This item of news is of interest to this country, because the Russians at present possess the only outlet to the Shenyi mineral district, by blocking which they would be able to discount the value of recent concessions. The French minister is to arbitrate in case of disputes. The line is about 900 miles long, and connects the capital with the great commercial centre of Hankau, on the Tang-tse-Kiang, passing through Chi-li, Ho-nau, and Hu-pei.

LAST Friday the first part of the Government inspection of the Great Central Railway works took place. The section visited was at the southern end, between the junction with the Metropolitan Railway outside Quainton-road Station and Finmere Station—some six miles in all. Colonel Addison was the inspecting officer. To meet him and conduct him over this piece of line the locomotive superintendent of the Great Central Railway, with several other officials, had come from Sheffield with three of the newest Great Central engines, and some saloon carriages, these being the first to run through. The running was found to be surprisingly smooth for a new road. The inspection passed off satisfactorily, the two stations examined—those of Calvert and Finmere—being almost complete.

THE derailment which occurred some time ago on the London and South-Western Railway near Tavistock prompted the suggestion by Lieut.-Colonel Yorke—who reported on the accident—that 82 lb. rails were not strong enough for heavy passenger traffic at more than 40 miles an hour. Commenting on the report, our American contemporary the *Railroad Gazette*, says the Empire State express of the New York Central, running most of the way at 60 miles an hour, and in many places at 70 miles or faster, runs every day on rails weighing only 80 lb. to the yard, and formerly ran at the same speed on rails weighing only 65 lb. to the yard. The engines of this train have about 20 tons—40,000 lb.—on each pair of driving wheels, the driving wheel base being 8ft. 6in. Similar conditions are to be found on other large roads. But, as everyone knows, the sleepers in American track are very much closer together than in England, generally 24in. or less, centre to centre.

THE proposal to establish a working arrangement, amounting practically to amalgamation, between the South-Eastern and London, Chatham, and Dover Railway Companies is said to have been received with so much favour by the respective boards that a Joint Committee, composed of three directors from each company, is now meeting weekly to settle all the details prior to an application being made for parliamentary powers to sanction the agreement. The scheme has often been suggested, and its early realisation has been rendered possible by the better understanding which has latterly been arrived at in the conduct of the two undertakings. Both boards have come to the conclusion that there is a wasteful expenditure which nothing can arrest short of a working arrangement in relation to all branches of traffic on the two systems. It is therefore proposed that next session a Bill shall be introduced providing for the constitution of an Executive Committee, which shall have absolute control over both railways, the affairs of the companies being directed by one staff from a common centre, and it is calculated that at least £100,000 per annum will be saved as the first result of the new arrangement. We understand that there will be no attempt made to mix the two capital accounts.

THE Committee appointed by the Board of Trade to inquire into the subject of train communication between railway passengers and the guards and drivers have reported to the department as follows:—(1) That of the methods of communication at present adopted the outside cord system should be condemned as inefficient, while the systems in which the cord or wire is inside the carriages cannot be regarded as satisfactory; the principal electrical systems and the communication by means of the brake may, however, be held to be efficient; (2) that no one of the electrical systems so far excels the others as to enable the Committee to recommend it for general adoption, although they prefer the system of communication which has been experimentally used by the Great Eastern Railway Company; (3) that the law should be extended so as to require the provision on all trains of an efficient means of communication between passengers and the servants in charge of the trains, which should also be used as a means of communication between the guards and the driver. The following are the conditions which, in the opinion of the Committee, a method of communication should fulfil:—(1) It should be one which would lend itself readily to the interchange of carriages between different railways; (2) it should be easily applicable, and should communicate directly with the driver as well as with the guards, whilst the means by which it is actuated by the passenger should be in a conspicuous position, either in the centre or at both ends of the compartment, without affording too great a temptation to passengers to tamper with it; (3) it should be reasonably cheap as to both initial cost and maintenance; (4) it should afford an indication outside the carriage of the compartment from which the communication has been made, and a passenger should not be able to replace the means by which the alarm is given; (5) it should not entail the use of additional couplings to those already existing—namely, the screw coupling, the side chains, the automatic brake, and the heating apparatus—where in use; and (6) it should be capable of being used as a means of communication between the driver and the guards of a train as well as between the passenger and the driver and guards. The signatories to the report are Sir Thomas Blomefield, chairman, Sir William Birt, Sir Douglas Fox, Major-General Hutchinson, and Mr. Gerald Loder, M.P.

## NOTES AND MEMORANDA.

THE North German Lloyd steamer, Kaiser Wilhelm der Grosse, on her last westward trip made an average of 22·07 knots, her days' runs being 453, 560, 560, 560, 554, and 443 knots.

THE direct measurement of a quantity of electricity in electro-magnetic units and its application to the construction of a current meter formed the subject of a paper recently read by M. R. Blondlot, of Paris. A coil in the form of a ring is hung on a vertical axis inside a long horizontal bobbin, the same current passing round both coils. The product of the intensity of the current into the time of oscillation—that is, the quantity of electricity which traverses any given section of wire during one swing, is a constant quantity, depending only on the construction of the two bobbins. By the application of a device for counting the vibrations of the small coil, a practical coulombmeter is obtained, which works equally well with continuous and alternating currents.

AT a recent meeting of the Royal Dublin Society, Dr. F. T. Trouton, F.R.S., communicated a method of measuring the surface tension of liquids which depends on the rate at which a column of liquid fills or empties itself out of a tube of fine bore. The tube is placed horizontally and has one end bent downwards into a vessel of the liquid. By altering the level of the liquid it can be either arranged to measure the rate the tube fills, in which case the capillary forces draw the liquid up, or the rate of emptying, the capillary forces retarding. Were the flow viscous the distance traversed would be proportional to the square root of the time. This was shown to be approximately true. Experiments were described using an inclined tube with a wide bent-down portion attached to the lower end. The rate of emptying could be made constant by making the height of the liquid in the wide part equal to the capillary elevation in the fine tube. Experiments were also described made with liquids such as soap solution, where surface tension varies with time.

A VALUABLE circular—No. 18—dealing with the physics of timber has just been issued by Professor B. E. Fernow, Chief of the Division of Forestry of the United States Department of Agriculture. The paper is given exceptional importance by the development of a formula worked out by Mr. S. T. Neely, showing how the strength of beams can be determined from the compression strength. In testing timber to obtain its various coefficients of strength, the test which is at once the simplest, most expedient, satisfactory, and trustworthy is the "compression endwise test," which is made by crushing a specimen parallel to the fibres. All other tests are either mechanically less easily performed, or else, as in the case of cross-bending, the stresses are complex, and the unit coefficient can be expressed only by depending upon a doubtful theoretical formula. It is, therefore, of great practical value to have a relation between the cross-bending strength—the most important coefficient for the engineer—and the compression strength, and this is what Mr. Neely has found. His discovery is expressed in the following conclusion:—"The strength of beams at elastic limit is equal to the strength of the material in compression, and the strength of beams at rupture can be directly calculated from the compression strength; the relation of compression strength to the breaking load of a beam is capable of mathematical expression." This enunciation, says *Nature*, is of far-reaching importance, and a comparison if calculated with observed results given in the circular is convincing as to the efficiency of the formula. It is to be hoped that other and similarly successful scientific investigations into the physics of timber will be made in the United States Division of Forestry.

AT a meeting of the Aëronautical Society, held on Friday last at the Society of Arts, under the presidency of Lord Mountmorres, Mr. G. L. O. Davidson read a paper on the subject of mechanical flight, entitled "The Flying Machine of the Future." He asserted that a machine made by man would fly, as do birds, if so constructed as to comply with the laws of nature with which birds complied. He did not suggest that the intermittent or reciprocal movements of birds' wings must be imitated, but he pointed out that no bird or flying creature had any motion, reciprocal or other, by which it attempted to screw itself horizontally through the air, as a fish screwed itself through water with its tail, and submitted that it was absolutely at variance with the laws of nature to employ as a substitute for the reciprocal action of birds' wings a screw propeller designed to push a structure horizontally through the air. That had been the general line of experiment during the last few years, but he was convinced that no more practical results would be obtained by aërodromes driven through the air by propellers than were now attained by balloons. He proceeded to give a general idea of the nature of the air-car designed by himself. He did not profess to be the first to think of raising a structure in the air by rotary lifters or of designing a machine to glide forward through the air, but he believed he was the first to attempt to combine the two and to add an automatic method of retaining equilibrium. His machine had two sets of aërocurves. The rotary ones, inside the fixed outspread ones, were forced through the air at an angle upwards by energy applied direct from the engines, thus giving a vertical lift, while the fixed ones afforded support in gliding forward. By experiment he had been able to find a lifter of a satisfactory shape, such that it could lift, even when of so small a diameter as 4ft., a weight greater than that of the structure required to contain it and the driving engines.

AT a meeting of the Physical Society, held on Friday last, Professor Carus-Wilson exhibited an apparatus to illustrate the action of two electric motors, coupled in such a way as to admit of their rotating at different speeds. The two shafts are placed in line, and each is fitted with a bevel wheel, gearing into an intermediate wheel. The axis of the intermediate wheel is at right angles to the line of the motor shafts, and is free to rotate in a plane at right angles to that line. The motors can be made to rotate at different speeds by altering the strength of the magnets of either or both. The motion of the intermediate wheel depends upon the difference of the two speeds, or upon their mean, according to their relative directions of rotation. A simple graphic construction enables the action to be predetermined for any given load on the intermediate wheel. Calling the two motors A and B, and the intermediate wheel C, lines can be drawn on a base of current, to represent the speeds and the torques for each motor. If the motions of A and B are in the same direction, the load or torque is the same on each, and of similar sign. Hence, as the load on the wheel C is increased, the speeds of A and B tend to become equal—if A had been running faster than B—and for a certain load on C, the speeds of A and B will be equal. If the load on C is further increased, B will run faster than A; also, there will be a certain value for the load on C, at which the motion of A will reverse. A further increase of the load on C will bring C to rest, A and B then rotating at equal speeds in opposite directions. When the load on C is nothing, let the motors rotate in opposite directions, A running faster than B. The motion of C now depends upon the difference of speeds of A and B. When a load is put on C the motion of A is retarded, while that of B is assisted; hence B takes less current and A takes more. The torques on the two motors, due to the load on C, are now of equal amount, but of opposite sign. As the load on C is increased the speed of A is reduced and that of B increased, until the two are equal and C comes to rest. B is now acting as a generator, and sending current into A. If the load on C is simply that due to friction, the process cannot be carried further; but if the load on C is reversed, the speed of B becomes greater than that of A, and the motion of C is reversed. In the steering gear, designed by the Union Electricitäts Gesellschaft, the intermediate wheel is made to actuate a rudder, by differential action. The motion is reversed by making the speed of one motor greater or less than that of the other.

## MISCELLANEA.

A FIRE broke out during Monday night at the millwright's shop in Portsmouth Dockyard. The police were engaged for two hours in extinguishing the flames, which they prevented from reaching the saw-mills below the shop, where much timber was stored. Though less damage was done than might have been expected, some valuable machinery was destroyed.

ACCORDING to Mr. Vice-Consul Tonietti's report on the trade and commerce of the island of Elba for 1897, the iron ore mines have been leased for twenty years, which may be extended for another five, to a young and distinguished Elban, the Chevalier Ugo Ubaldo Tonietti, for a royalty of 7 lire 25 c. per ton of ore exported to foreign countries, and only 50 c. per ton of ore consumed in the country. The magnitude of the royalty does not appear to inconvenience the lessee in his foreign sales, judging from the energy with which he is working the mines and pushing the sales abroad, especially in England and Germany, to meet whose demands he has constructed the latest means of transport and machines for washing the ore, and he is doubling the facilities for shipping.

THE Committee of the Scientific Societies of Glasgow, formed for the purpose of organising a fitting reception for the British Association when it visits Glasgow in 1901—the year of the projected International Exhibition and the opening year of the twentieth century—has resolved to prepare elaborate hand-books relating to Glasgow and the Clyde Valley, and dealing with such subjects as archæology, geology, natural history, and engineering and shipbuilding industries. The preparation of each hand-book will rest with a Special Committee, that on engineering and shipbuilding having as its convener Mr. Robert Caird, of Messrs. Caird and Co., Greenock. The guarantee fund for the Exhibition has now reached close on £400,000, and special efforts for the first time are about to be made to increase the total amount to at least £500,000.

WE are informed by the High Commissioner for Canada that the official returns of the external trade of Canada for the ten months ended April 30th last have just been issued. The total trade amounted to 244,501,000 dols. as compared with 204,435,000 dols., in 1897, an increase of 40,000,000 dols. The imports entered for consumption, which in 1897 were 93,498,952 dols., were in 1898 106,286,484 dols. This is exclusive in both cases of coin and bullion. The exports of Canada, exclusive of coin and bullion, amounted to 130,090,077 dols., as compared with 102,943,632 dols. in 1897, an increase of over 27,000,000 dols. Of the produce of Canada the increase in the exports were principally in the produce of the mines, 3,000,000 dols.; agricultural products, 15,000,000 dols.; animals and other products, 6,000,000 dols.; and manufactures, 1,164,000 dols.

THE crops to be raised on the sewage filter beds at Altoona, Pa., U.S.A., this year will include oats, corn, potatoes, cabbages, onions, and peas. A record of the dosing of these beds during the last five months of 1897 shows that on the average each of the thirty-six beds received sewage for 308 hours, which disappeared in 110 hours after the flow was stopped. Some of the beds were not used the whole of the time, the average time in use being 129 days, during 19 of which the beds were wet—sewage being applied or not having disappeared—leaving 110 days on which the beds were dry. The exact amount of sewage treated is not known, but is estimated at sixty gallons per day for 13,000 people, or 780,000 gallons. The total area of the beds, including embankments, is 64,469 acres, an average of 1791 acres per bed. The level area adapted to cultivation is 56·8 acres.

THE Hartlepool Harbour Commissioners have appointed Mr. Albert Nagel to be their engineer and secretary. At the end of his apprenticeship, in 1886, Mr. Nagel obtained the degree of Bachelor of Science in the Department of Engineering at Edinburgh University. After taking his degree he was for about a year lecturer on surveying and civil engineering in the Durham College of Science, Newcastle-on-Tyne. His practical experience has been on an extensive scale. While serving his apprenticeship, he took part in complete surveys of the docks and of the estuary of the Tay, and in 1888—89 he was contractor's chief engineer for the alterations on the Newcastle Central Station. For two and a-half years he was employed undertaking important duties in connection with the construction of the Manchester Ship Canal, and more recently was entrusted with engineering investigations for colonial Governments.

THIS country is apparently not alone in its sewage problems. We learn that double intermittent filtration through coke breeze, preceded by the passage of the sewage through screens of fine mesh, has been recommended for the sewage of Columbus, Ohio, U.S.A. A total filtering area of 36 acres is proposed, divided equally between beds of fine and coarse grain, each bed to have an area of one acre. The estimated cost of the purification plant, including land, is 508,600 dols., of which about 330,000 dols. is for the filter beds. The estimated amount of sewage to be treated is 15,000,000 gallons ordinarily, with 20,000,000 gallons as a maximum. The operating expenses, interest, and depreciation, together with the cost of pumping, are estimated as amounting to 36,973 dols. a year, of which 25,000 dols. is for labour and material at the beds. It is suggested that two beds be constructed and carefully studied for one season under the direction of a competent chemist before proceeding further.

A SET of sheer legs, 87ft. in height, and with a lifting capacity of 75 tons, erected on the jetty of the Keyham North Basin at Devonport, collapsed on Wednesday afternoon, as the result of being struck by the bowsprit of the Temeraire battleship. The vessel was being moved from the north to the east side of the basin, when the hawser snapped, and she swung round with sufficient force to break off the cast iron bracket securing the heel of the legs, and the whole structure came down. Two of the legs fell across the roadway outside the quadrangle, blocking the railway and other means of communication, and a third leg went into the basin. A leading man of riggers received some contusions, but with this exception all the men at work in the vicinity escaped without injury. It was found impracticable to remove the obstruction last evening. The structure is described as practically wrecked beyond repair. An inquiry into the cause of the accident has been ordered to be held on Thursday.

DR. C. LE NEVE FOSTER, one of her Majesty's inspectors of mines, and Mr. A. E. Miller have furnished the Home Secretary with reports upon the circumstances attending the underground fire which occurred at the Snaefell Lead Mine, Isle of Man, on May 10th, 1897, and by which twenty lives were lost. The fire, he says, was caused by a lighted candle being stuck up against one of the timber supports, and that the deaths of the twenty men were due to carbon monoxide produced by the timber burning in the mine. Dr. Foster suggests, as a means of preventing outbreaks of this character, either that the timber used for supports should be rendered non-flammable—that is, not easily ignitible—or that it should be replaced by non-combustible materials such as masonry, brickwork, concrete, iron, or steel. If a fire occurred, like that at Snaefell, its consequences might be rendered less deadly by the adoption of the following remedies:—(1) Inspection previous to work; (2) mechanical ventilation; (3) cages for raising and lowering men; (4) apparatus for penetrating into noxious gases; and (5) supply of compressed oxygen. If there had been a rule prohibiting the men generally from entering the mine until after an inspection of the working places, the death-roll would have been much smaller. The rescue of the sufferers and the recovery of the bodies was greatly impeded by the want of proper appliances for raising and lowering the men. The use of oxygen in restoring sufferers from carbonic oxide poisoning, Dr. Foster says, is now too well established to need any special remarks.

# AMERICAN TRACTION ENGINES

(*For description see page* 16)

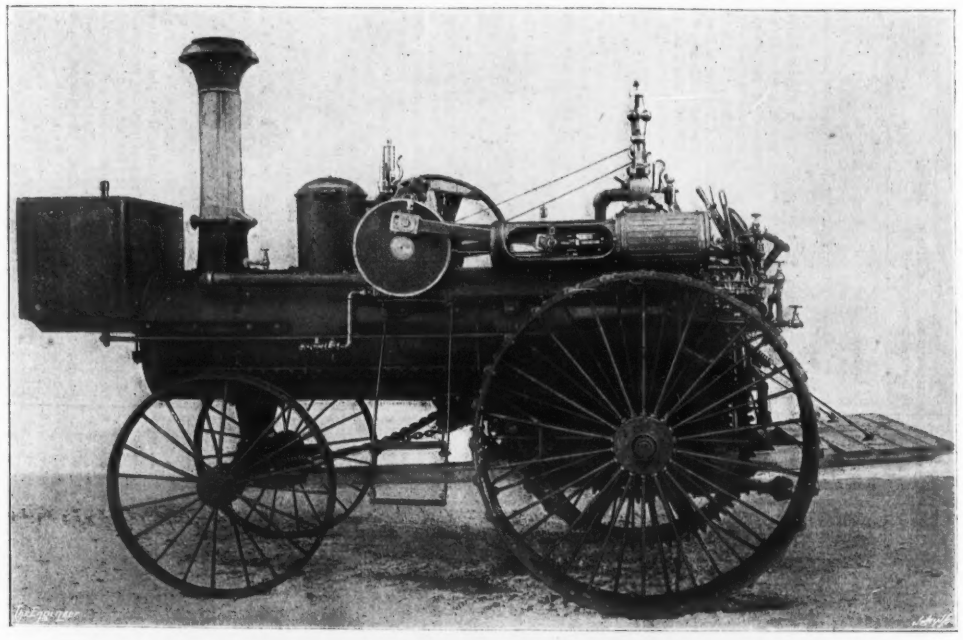


Fig. 16—PITTS SIDE CRANK TRACTION ENGINE

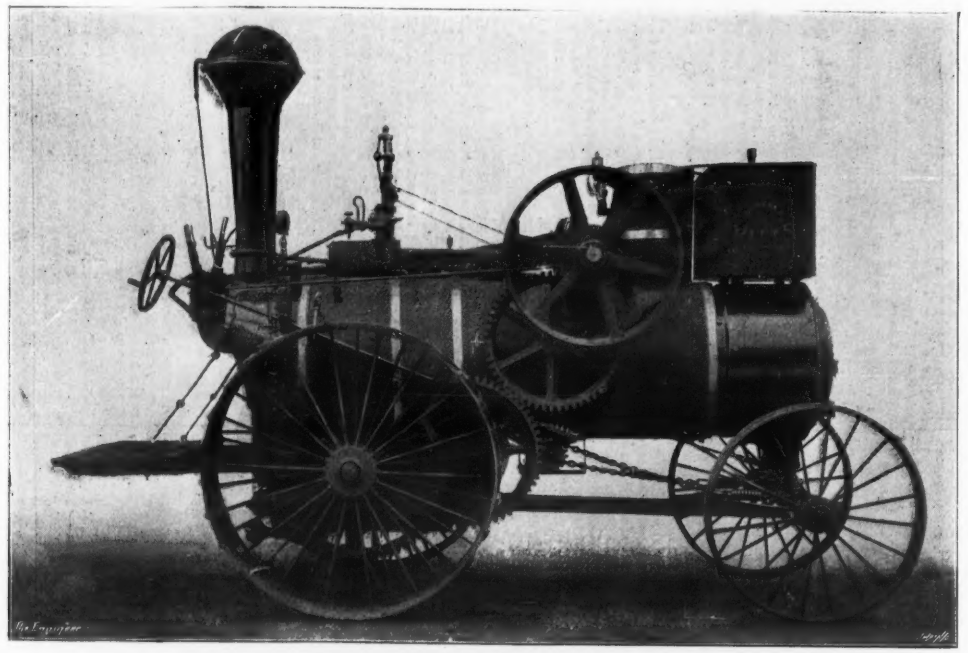
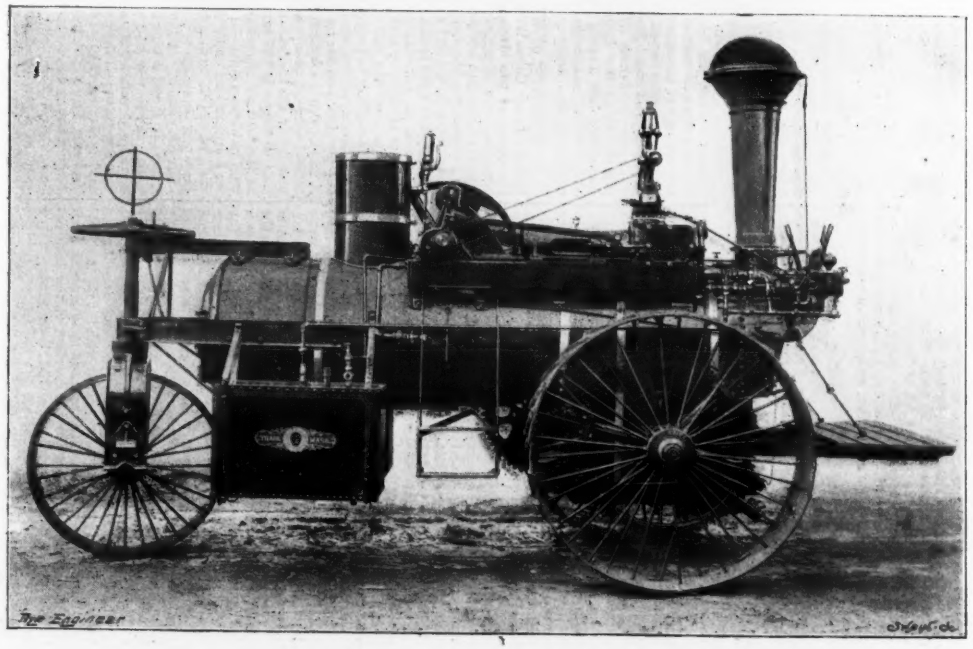


Fig. 17—PITTS' STRAW-BURNING TRACTION ENGINE



ig. 18—PITTS' STRAW-BURNING TRACTION ENGINE

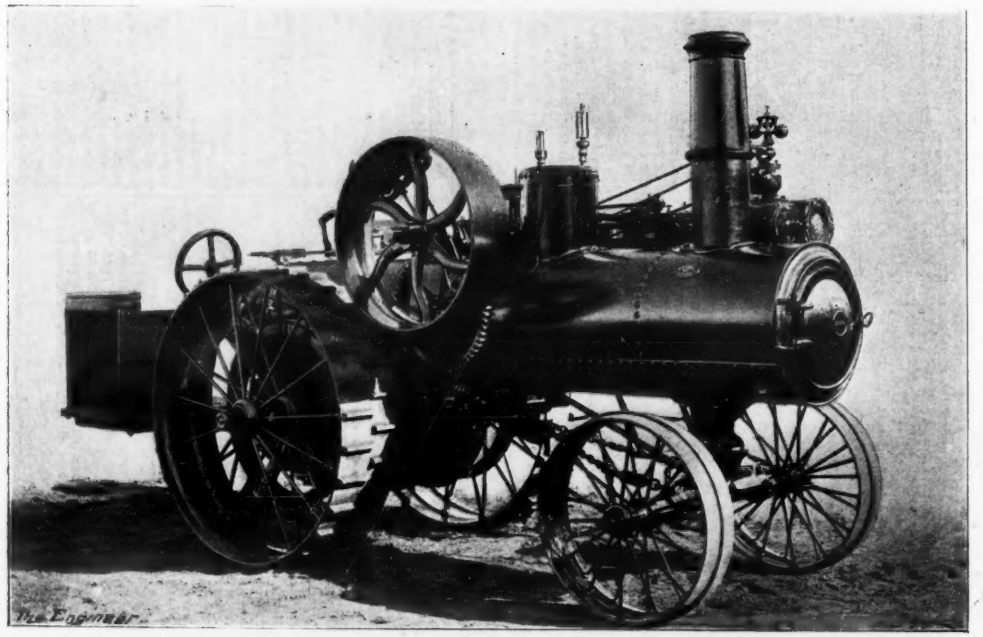


Fig. 20—PORT HURON TRACTION ENGINE

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*** *In order to avoid trouble and confusion we find it necessary to inform correspondents that letters of inquiry addressed to the public, and intended for insertion in this column, must in all cases be accompanied by a large envelope legibly directed by the writer to himself, and stamped, in order that answers received by us may be forwarded to their destination. No notice can be taken of communications which do not comply with these instructions.*

*** *All letters intended for insertion in* THE ENGINEER, *or containing questions, should be accompanied by the name and address of the writer, not necessarily for publication, but as a proof of good faith. No notice whatever can be taken of anonymous communications.*

*** *We cannot undertake to return drawings or manuscripts; we must, therefore request correspondents to keep copies.*

### REPLIES.

PNEUMATIC HAMMER.—A letter lies at our office for Mr. James Dunlop, of Manchester.

S. C.—We believe this matter has not yet been decided. No information has been published concerning it so far as we are aware.

HESPERIDES.—The volume of the gas will vary in the inverse ratios of the pressures; that is to say, double pressure, half volume, and so on.

D. N. (Manchester).—If by full speed you mean contract speed, there is no vessel in the British Navy which could steam at that rate for ten days; coal has nothing to do with this. Neither can any vessel in ours or any navy carry coal enough to steam at full sea speed for ten days.

M. S. H. (Scarborough).—We cannot pretend to give you the addresses of all the companies which insure or assure boilers. You will find the names and addresses of the more important in our advertising columns, and in the directories of Manchester, Birmingham, and London.

### INQUIRIES.

JACKSON'S BELTING HOOK.

SIR,—Will any reader be good enough to furnish us with the address of the maker of Jackson's patent hook for belting?

London, June 29th. B. B. AND CO.

### MEETINGS NEXT WEEK.

ROYAL INSTITUTION OF GREAT BRITAIN.—Monday, July 4th, at 5 p.m., General Monthly Meeting.

THE INSTITUTION OF JUNIOR ENGINEERS.—Saturday, July 9th, Excursion down the River by P.S. Alexandra. Leave Westminster Pier 2.15 p.m., calling at Temple, Old Swan, and Woolwich.

# THE ENGINEER.

*JULY* 1, 1898.

### THE FLASH POINT.

IT will possibly be news for many of our readers that a Parliamentary Committee has been sitting for some time to consider the whole question of legislation affecting the sale of petroleum in its various forms. Such is, however, the case. The Committee was called into existence by the outcry of those who maintain that numbers of men, women, and children are slain every year by lamps burning some of the paraffin or mineral oils. Amid a great clamour of tongues, one phrase more persistently heard and more constantly heard than any other was, "raise the flash point." Now, and for some years past, the standard flash point by "Abel's test" is 73 deg. Fah. This means that the oil tested must not give off an inflammable vapour at a lower temperature than 73 deg. The report of the Committee will probably soon be made public. By a majority of one it recommends the flash point to be raised to 100 deg. The conclusions which Mr. Ure invited the Committee to endorse were:—(1) That, practically, complete immunity from lamp accidents would be attained if only oils with a flash point above 100 deg. Fah. were in common use as an illuminant; (2) that this object would be secured without legislation absolutely forbidding the use as an illuminant of oil with a flash point below 100 deg. Fah. by a simple enactment substituting 100 deg. Fah. for 73 deg. Fah. where it occurs in the Act of 1879. Mr. Ure is the member for Linlithgow, a circumstance which, it will be seen presently, is not without an important bearing on the case. Mr. Jesse Collings, the chairman of the Committee, had drawn up a draught report, in which the flash point remained at 73 deg. This section of the report is therefore now excluded from further discussion; and if the Committee has its own way, in future the flash point will be 100 deg. Fah.—Abel's test, corresponding, it has been estimated, to about 136 to 138 deg. for the common "open test." It is not necessary at present to go into any technical details, or to consider the matter from the chemist's point of view; that may be done by-and-bye perhaps with advantage. For the moment we are chiefly concerned with the reasons for and against the augmented flash point temperature.

There are two classes or types of mineral illuminating oils in the market—to wit, the American and the Scotch. The former represents the lighter oils, with a low flash point; the latter heavier oils, with a high flash point. When this is understood we can comprehend the policy of the member for Linlithgow. Very naturally he wishes to serve Scotland. Enormous quantities of American oil would at once be excluded from the British market by the proposed rise in the flash point. But it is practically certain that this would be followed by a rise in the price of oil; a matter which would be received with jubilation by the Scotch oil distillers. The result would be practically the same, indeed, as if an import duty were placed on American oils. On the other hand, Mr. Collings is known as the countryman's friend. He has taken the needy agricultural labourer under his wing, and feeling that a rise in the flash point means a rise in the price of the liquid on which Hodge depends for light during the winter, he opposes the rise. Of course, it is perfectly understood that both gentlemen are influenced by other and most commendable motives; but the facts are as we say, and must be taken into account. There is some danger that, under the circumstances, the truth may be forgotten. In the desire to help the distressed—he says he is distressed—shale-oil distiller on the one hand or the impoverished—Mr. Collings says he is impoverished—farm labourer on the other, the real essence of the whole matter may be overlooked. There is no reason outside that already stated why the flash point should be raised, unless it can be shown that by raising it numerous lives will be saved which can be saved in no other way. Now on this most important point the evidence appears to us to be singularly inconclusive and unsatisfactory. In the first place, there is really no complete evidence that any one has been killed, say, during the last twelve months, because the flash point of petroleum illuminating oil was only 73 deg. Fah. Far too many persons are killed or grievously burned by petroleum lamps every year; but this has nothing to do with the question at issue, which is simply the part played in bringing about the catastrophes by the flash point. The theory is that the oil becomes heated in the lamp, gives off vapour, and explodes. At another time we shall deal with this question from the chemical point of view. For the moment it is enough to say that, according to eminent authorities, such a thing cannot happen at all. But leaving this on one side, it is not too much to say that the proof that such a thing does happen so often that the whole status and position of a considerable trade ought to be changed to prevent its recurrence, is far too weak and inconclusive to deserve much consideration. Here again we have to bear in mind that it is not enough to say that Mrs. Jones was burned to death or Mr. Robinson was terribly injured by the explosion of a paraffin lamp. It must also be shown conclusively that such calamities could not happen if the flash point were 100 deg. instead of 73 deg. There are, we know, certain enthusiasts who are quite prepared to maintain such a thing at all hazards. But we have never yet seen any satisfactory proof that would convince us that in a raised flash point lies absolute safety. Mr. Ure has satisfied himself that "practically complete immunity from accident would be secured," but we suspect that he will find some difficulty in making Parliament accept this conclusion as sound.

The fact is that, so long as mineral oil does not give off an inflammable vapour at the normal temperature of our dwelling-houses, we may regard the risk of using it as quite insignificant. We say "using" it. Ninety-nine "accidents" out of a hundred are due to the abuse of the oil, and not to its use. Anything that will burn in such a way as to give a light may also be treated in such a way as to cause danger. Gas and electricity are no exceptions to the rule. Women have been burned to death over and over again by candles falling out of the candlesticks and setting fire to their clothes. This same innocent candle has done quite as much mischief as the paraffin lamp, but so much is not heard concerning its misdeeds, because it does not make a fuss about them. The paraffin lamp is a very conspicuous engine of destruction. It gives the newspaper reporter chances for the concoction of literature which are not concomitant with the candle. The true sources of all this mischief may be classed under two heads—first, bad lamps; second, carelessness. Perhaps we may add a third, although it is somewhat outside the scope of a technical journal—we refer to the use of the paraffin lamp as a weapon, for which purpose, judiciously employed, it has no equal outside a gunsmith's shop. To us the idea that merely raising the flash point can secure safety, while incendiary machines in the shape of lamps are suffered to be sold for a few pence, is little short of fatuous. It is the lamp, not the flash point, that is wrong; and we have not the least hesitation in saying that while raising the flash point will at once be followed by a rise in the price of oil, it will do next to no good unless the lamps are improved. Indeed, it seems to be obvious that to raise the flash point, and do nothing to improve the lamps, will be simply to hold out a premium for the sale of worse and more dangerous lamps than ever. Can anyone suppose that because the flash point has been raised 27 deg., the contents of a lamp will not take fire if the lamp is knocked down and broken, and the oil is spilled over the floor or the dress of a woman sitting by? Everyone who has dealt with the subject has denounced the glass reservoir lamp. It should never be used save for the best and most expensive lamps, which are so made that they are not easily overset, and are treated with far more care than the ordinary cheap article, which can, indeed, be bought for a few pence.

There remains for consideration the fact that the flash-point is by no means a certain guide to the quality as regards safety or the reverse of an oil. That is a matter which we content ourselves just now with naming. As, of course, the full text of the Committee's report is not yet published, we are unable to say how far they have or have not recommended an enforced change in the construction of lamps. We can only hope that they have recognised their importance. We have on our side the opinion of so eminent an authority as the late Sir Vivian Majendie, who maintained that the existing flash point provides a perfectly safe oil so long as even a moderately good lamp is used to burn it. Indeed, no one can realise how safe it is until he has, like ourselves, examined some of the cheap lamps in which it is burned year after year without causing an accident.

### THE COAL STRIKE.

IF there are a few more promising signs on the horizon in South Wales, they can scarcely be attributed to the debate in the House of Commons last week, and still less to the painfully non-committal speech of the President of the Board of Trade. So far as the facts lent themselves to intelligible explanation, they have been fully described to readers of THE ENGINEER, and the statements of the Welsh members—representing, by the way, both political parties—cannot be said to have added to the general stock of information. All that the representatives of South Wales constituencies could do was to appeal to Mr. Ritchie, and truly at the present juncture he appears more than ever to resemble a good man struggling with adversity. The burden of the arguments pointedly addressed to the Government and the Board of Trade was that they had the power of the

Conciliation Act at their back; that Mr. Ritchie was in a position to call the contending parties together; that, his own personal persuasions failing, he could appoint a mediator, an arbitrator, some sort of a *deus ex machinâ* who would place a fretful region once more on terms of peace. But what, after all, is the Conciliation Act? It is a permissive measure, and we take leave to say that if it had been made compulsory in its application the employers and the workmen alike would have denounced it as an excessive instance of grandmotherly legislation, and would have joined forces to prevent its passage through Parliament. The Conciliation Act, as Mr. Ritchie explained, is only operative when his aid and influence are invoked by one or both of the combatants in industrial strife. That marks an advance, no doubt, upon the position he originally took up. In reply to the deputation of South Wales Mayors and Members of Parliament, he was understood to say that he must be approached by representatives of the coalowners as well of the colliers, before he could officially move in the direction of cutting the Gordian knot. From Mr. Ritchie's later announcement it would seem to be open for "Mabon," M.P., and the rest of the more or less representative leaders of the men, to put in an appearance at Whitehall, and say, "The points in dispute are at last so small that you could probably help us to settle them in one day's conference." That, at any rate, was the interpretation which "Mabon" and the more pacifically-inclined of his colleagues placed upon the ministerial statement. They were appointed a deputation at noon on Tuesday, and they met the President, not at Whitehall, but in the House of Commons, at ten p.m. the same day. There was a lengthy discussion, it would seem, in which Mr. Ritchie bore a constant note of interrogation on his forehead. The interview ended with a promise from the President of the Board of Trade that he would give an answer to the request of the delegation in twenty-four hours. But the comment of the coalowners on this proceeding is sufficiently obvious beforehand. They may reasonably ask, "Why go to Mr. Ritchie when there is still an open door for you in the council chamber of our Emergency Committee? What is there for the President of the Board of Trade to decide that we cannot come to conclusions about among ourselves? We have been our own mediators for twenty years, through the Sliding Scale Committee, and where is the necessity for State interposition in a dispute of which the circumstances are better understood between us than they can be by the most painstaking Conciliator Mr. Ritchie could appoint."

The fact cannot be ignored that the non-committal tone of Mr. Ritchie's remarks in last week's debate on Mr. Brynmor Jones's motion, has done more harm to the colliers' cause than all his platonic expressions of sympathy with a suffering community, and good wishes for a speedy settlement of the costly and calamitous conflict. Of course he was bound to say something, and he found himself in a position of extreme difficulty; but the lack of definiteness and precision in his language has emboldened the more stubborn among the Welsh colliers to believe that, if they hold out long enough, Government must intervene, with the result of obtaining for them better terms than they might secure by direct negotiations with the committee of the Coalowners' Association. It is the stubborn men, mainly the younger men, the men with the loudest voices and the fewest responsibilities, who have precipitated and are maintaining the warfare. This is a section of the community, not in South Wales alone, but in all colliery districts, which is the least entitled to encouragement, and which ought most of all to be reprobated by a Minister of State. That, however, is not the only unfortunate mistake the President of the Board of Trade has made in connection with the South Wales crisis. It has to be inferred that he is but ill-acquainted with the actual state of affairs. He admitted as much when he told the House of Commons that he had despatched to the scene of the crisis a confidential agent of the Board, who had seen the leaders on each side, and on whose report his own opinion was mainly formed. Who the confidential agent was Mr. Ritchie declined to say—at least in public. But will it be believed that this special envoy from the Board of Trade did not take the trouble to ascertain the views of "Mabon" on the situation? "Mabon" is still a miners' agent as well as a Member of Parliament. He was a trusted Apostle of Peace, as a delegate of the workmen, for well nigh all the time the Sliding Scale Agreement remained in existence. He deprecated the inconsiderate action of a narrow majority of the men in handing in their notices last September. It is true he was tainted by the "control of the output" heresy; but he was bold enough to recommend the men to accept the employers' offer, and continue at work until April 9th, while important conferences were yet to be held, and for that he was temporarily dispossessed of his supremacy in the councils of his people. The confidential agent who claimed to have made an impartial inquiry among the leaders of masters and men, and who, nevertheless, left "Mabon" out of account, must have had very little knowledge of the work in hand, or represents such a singularly constituted type of the special envoy as to make us hope that the Board of Trade has not many more of the kind in its employ.

The signs that the deadlock is drawing nearer to its close are found in circumstances which have nothing to do with the deputation to Mr. Ritchie, or the possibilities of Board of Trade intervention. They are found in the fact that a number of reasonable men in both camps are sick and tired of a three months' suicidal struggle—sick at the suffering they see that it has already entailed, and tired of the inaction at the Associated Collieries while the non-associated pits are working at their utmost capacity, and in many cases have conceded, or been made to grant, a second advance of 10 per cent. in wages, making 20 per cent. since April 9th. To the weaker coalowners, and particularly to the shareholders in colliery companies, it is naturally galling that their properties should be idle and falling into decay, while their freer rivals, some of them the first advocates of controlling the output, are reaping a rich harvest and practically capturing the market. Sir William T. Lewis, and the larger coalowners, are probably as firm as Mr. Gascoyne Dalziel describes them—as obdurate as they are described in less friendly quarters. But to use a familiar engineering formula, the strength of a chain is in its weakest link; and the chafing, the ill-concealed irritation, of coalowners not so happily placed as Sir William Lewis, indicates a feeling that loyalty to the Association may involve too high a price—that the sacrifices now being made may bring no appreciable compensation in the future. And the simile of the chain and its weakest link is equally applicable to the position of a considerable body of the colliers. The anticipations they were led to indulge in as to the amount of relief they would receive from English and Scotch miners, and other trade unions this side Offa's Dyke, have by no means been realised. Nor have their funds come in at the rate expected from the men in the non-associated collieries who are working at an advance of from 10 per cent. to, as in the case of the Cambrian Collieries, 20 per cent. Only this week there was an acrimonious dispute whether the whole of the 20 per cent. advance should be paid over to the strike fund, or the contribution should remain at 1s. per head for adults and 6d. per head for boys. These passing phases of a situation which is always changing do not warrant a positive prediction. But they are distinctly significant, and give opportunity for the formation of more assured opinions than it was possible to derive from the House of Commons debate.

### YORKSHIRE COALOWNERS AND THE WORKMEN'S COMPENSATION ACT.

THE Workmen's Compensation Act, which comes into operation to-day, seems likely to be attended with bitter disappointment and hardship on a section of the workers whose welfare it was passed to serve. An early intimation has been received by the Yorkshire Miners' Association, for at a meeting of its Executive held at Barnsley on Monday, reports were laid before that body from various parts of the county showing that a number of men had been noticed to leave work on account of alleged bodily imperfections, such as dimness of sight and defective hearing. The men naturally offer a strong protest to such a movement; but on a careful consideration of the Act, they will not have much difficulty in seeing how such action is being brought about. No doubt the coalowners most deeply regret the circumstances in which the last enactment has placed them, for by many of the oldest firms whole families have been employed, having entered the pits as pony-drivers or trammers, and worked without interruption to an old age. If men suffer from some slight defect in sight or hearing, these are important considerations with an employer who is aware of his liability, for such men are obviously more subject to accident than those in full possession of their faculties. What is to be done for these people is a most important problem for those in charge of their interests to solve. The question of an old-age pension is very desirable, yet very difficult to work. It is to be feared that, so far as this country is concerned, it is now outside the region of probability, seeing that the men as a body have declined to listen to any outside details relative to the subject. As showing the difficulty of striding over the present unfortunate position, it may be pointed out that the West Riding of Yorkshire Miners' Permanent Relief Fund, which has 20,000 members on its books, is now seriously considering how to deal with the matter. Their idea of endeavouring to arrange a mutual scheme between owners and employés to take the place of the Act was to pay for all accidents, and proposed an old-age pension of 5s. per week for men over 65 years of age. This it was proposed should be done by the owners contributing 5d. per man per week, and the men themselves 3½d. to 3d. per week respectively underground and on the surface. However, on further probing into the question, the Board of Management of the society named has been obliged to withdraw the old-age proposal, acting upon actuarial advice. It is questionable whether they could undertake such a responsibility with such a contribution, and, assuming such could be the case, it was clearly stated that the fund must be supported for five years without any withdrawals in order to cope with the claims which were now ready for coming on the funds.

### COAL VALUES AND MINERS' WAGES.

COAL values are just now distinctly on the up-grade, and the circumstance is one which must have an appreciable effect on the trade of the country between now and the close of the year. When inquiry is made into the cause of the advance, recent legislation of a character designed to secure greater protection for the colliers in the carrying on of their occupation is found to be the explanation. When this legislation was going through Parliament it was recognised that, though the original burden was imposed upon the employers, the money would ultimately have to come out of the pocket of the consumer, and we are now witnessing the fulfilment of the prophecy. The Derbyshire, North Staffordshire, and other Midland coalowners have just submitted tenders for the annual gas coal contracts, and the tenders have shown a higher average than last year by 6d. per ton. This advance was determined on at a general meeting of owners, some of the firms advocating 9d. per ton advance. It is stated that the new prices vary from 7s. 3d. to 8s. per ton, compared with 6s. 9d. and 7s. 6d. last season. One of the largest contracts at present on the Midland gas coal market is for 500,000 tons. Similarly, this season's gas coal contracts in Lancashire, which have been hanging fire during the past months, owing to the higher prices demanded by the coalowners, are now being closed. In this case also prices represent an average advance of 6d. per ton upon last season's rates, and the common qualities of gas coal, such as Wigan 4ft., ranging from 7s. to 7s. 6d., and good screened Arley gas coals from 7s. 9d. to 8s. 3d. per ton at the pit mouth. Whether these prices will regulate those for the contracts which have yet to be dealt with may perhaps be open to question, but they represent a substantial upward move on the business done last year. In other descriptions of coal, both for house-fire requirements and for steam and forge purposes, similar advances on forward contracts are also being held out for, ranging from 6d. to 9d. per ton, whilst on engine classes of fuel quotations represent about 3d. to 5d. over last year's prices. It would have been very well if these increased values had gone into the pockets of the colliery proprietors, since no one can fairly say that they have of late been getting more than their due. It is clear, however, that with the high premiums now being asked by the insurance companies to cover the accident risks for which under the new legislation employers are made responsible, the pit-owners will not net much out of the advances. At next week's important conference between the Miners' Federation and the coalowners on the application for a further 10 per cent. advance, the men's leaders are certain to make the most of the current dearer fuel values. But it must be plainly shown to the delegates that owners' profits will benefit very little by the situation.

### ELECTRICITY IN ITALY.

ATTENTION is drawn by Mr. Consul W. Keene to the future which is opening in Italy for the development of electrical power from water supplies, particularly in Piedmont, which is rich in waterfalls. He thinks that there is here an opportunity for English companies to enter into large contracts for the supply of electricity, and to start establishments for the manufacture of electrical appliances. The use of electricity for lighting, for driving tramways, for running factories, and for various uses, is making rapid strides in Italy. In Genoa and its district alone a great deal has already been done. There are 70 kiloms. of electric tramway in Genoa itself, over which 1,634,000 car kiloms. were run in 1897. The line is metre width, and works on the overhead system. The rails and electric appliances were, we notice with regret, furnished by the Allgemeine Elektricitäts Gesellschaft, of Berlin. At Spezia the naval dockyards are already lighted by electricity, and a project for lighting the principal streets of the town is now under consideration. At San Remo nearly all the best villas and hotels are lighted by electricity supplied by the Co-operative Electric Lighting Company, and at Ventimiglia electricity has almost entirely superseded gas as an illuminant. Both there and at Bordighera, where it is also making progress, it is supplied by an English company. In Turin electrical industries are rapidly developing, mostly under the guidance of Swiss and German companies associated with Italian houses. It is expected that the complete network of electric tramways in Turin will be open by the time of the National Exhibition, which is to be held this year, and Turin will be then one of the towns in the world best supplied with tramways. From all this it will be seen that there is much support for the Consul's observation; and if financial arrangements were only a little more stable in Italy, the field would indeed be good for English enterprise. But how is it, we may ask, in passing, that German companies manage to get on so well in spite of financial crises?

### THE IRON INDUSTRY OF RUSSIA.

THE returns recently published show that during 1897 there was a great increase in the production of pig iron, steel, and iron in the Russian empire. According to these figures it seems that in the course of the year 113,982,000 poods of pig iron were produced in Russia, while the production of iron and steel amounted to 30,610,984 and 52,963,928 respectively. The imports from abroad amounted during the same period to 6,238,000 poods of pig iron, 24,294,000 poods of raw iron and steel, 1,834,000 poods of iron and steel ware, and 4.585,000 poods of machines and apparatus. The Russian weight of one pood is equivalent to 36 lb. avoirdupois. The imported metals, raw and otherwise, show an increase of 1,122,000 poods on the quantity imported during 1896; and it is clearly seen that Russia required in 1897 the total quantity of 166,326,000 poods of pig iron in order to meet home wants, and this represents an allowance of 1·33 poods to each unit of the population. But Russia was obliged to import 2,090,000,000 lb. of iron, or rather more than 16½ lb. per head of the population. Although the importation of raw iron, steel, and pig iron, so far from showing a decrease in quantity, shows an increase as regards the figures for 1896, yet the returns are more favourable from the point of view of home production, since the percentage of imported iron and steel as compared with the total quantity used was 134·2 in 1896, and 31·4 in 1897.

## LITERATURE.

*An Eight-hours Day.* By W. J. SHAXBY. London: The "Liberty Review" Publishing Company, Limited. 1898.

THE sub-title of this book is "The Case Against Trade Union and Legislative Interference," and is in effect a companion volume to the author's "The Case Against Picketing," published in the autumn of last year. Mr. Shaxby takes as his text an expression by Professor Marshall to the effect "that a general reduction of the hours of labour is likely to cause a little net national loss and much moral good," with the qualifying statement that "State interference and trade union compulsion cannot be too strongly condemned." It is only to be expected that any book issued under the auspices of the Liberty and Property League should have a strong individualistic moral running through it, and such is the case in an "Eight-hours Day." By all means have an eight, a seven, a six, or an any hours day you may like, as long as the requirements of any given trade fix such hours; but these requirements must be determined by the individuals directly concerned in those trades, and must not be forced, *nolens volens*, upon the workers by an outsider, whether in the shape of a grandmotherly Government or a notoriety-hunting trade agitator. Such is the theory of this book, and it is worked out systematically and well.

The author begins by dealing with the arguments for and against a legal eight-hours day; and with regard to the social aspect of the question, he tells us that "both socialist and anti-socialist alike are now pretty well agreed that the reduction of working hours to the lowest number possible is desirable, as far as is consistent with the prosperity and welfare of the commercial life of the nation." He advocates that employer and employed should be drawn closer together, and manage their own affairs directly rather than through the intermediation of outsiders. A number of well-known authorities on these matters are quoted, such as Thorold Rogers, Ives Guyot, John Rae, James Annand, Hadley, Sir Robert Giffen, Sidney Webb, and others. The incoherent arguments of people of the stamp of Messrs. Tom Mann, Hyndman,

"Honest" John Burns, and their friends, are dealt with, and their fallacies laid bare. The author describes his book as being composed of a series of notes so arranged as to form a readable hand-book, and that is really what it amounts to. It is of a convenient size, and not too big, both excellent features in a book on the labour question; for while in times of strikes people will devote much study to this sort of subject, they will not when peace or a patched-up truce prevails go to the trouble of perusing a heavily-written treatise.

In a few words, it may be said that Mr. Shaxby's book is a concise summary of the eight-hours day question, which, while having a distinct anti-trade union leaning, gives the arguments of both sides a fair hearing. It is couched in moderate language, which is unusual in labour literature, and it is devoid of that sort of bogus sentimentality and faddist theory which so often detract from the value of works of this description. We must have labour literature at the present day, for the question is one which, much as it is generally disliked, a large section of the British public is bound to follow. It is true we should be vastly better off if about three-fourths of that which has been already published had never seen the light of day. However, Mr. Shaxby's present book is not to be classed with the majority. It is a healthy and straightforward little volume, and is a distinct addition to the few books that really go to throw some light on the complicated subject of present-day labour.

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*Report on the Prospects of Irrigation and Water Conservation in New South Wales.* By COLONEL F. J. HOME, C.S.I., Royal Engineers (retired). Sydney: William Applegate Gullick, Government Printer. 1897.

IN this Australian Blue-book is printed a report on possibilities of the water supplies of the river basins of New South Wales as regards irrigation. Colonel Home, a retired Royal Engineer of the Irrigation Department of India, applies his experience of that country to a somewhat cursory preliminary examination of the problem as applied to the Australian Colony. In this he devotes most of his attention to the capabilities of the Murrumbidgee and Darling tributaries of the Murray River. In the basins of these tributaries several favourable sites for reservoirs have been discovered, and some promising irrigation schemes sketched out by Mr. H. G. McKinney; but Colonel Home arrives at the conclusion that the east coast river basins do not demand any irrigation on a large scale, owing to the dampness of their climate, their favourable rainfall, and the want of level ground; that all the rivers flowing to the west of the dividing range are too irregular in their supply to favour irrigation, except on a small scale, and sites where water can be stored at a reasonable cost are extremely rare. The Murray and Murrumbidgee rivers being fed by snow from the Australian Alps, are most favourably situated; but even in this case a moderate-sized canal could not be supplied by them without the aid of storage.

Two projects from these rivers have been selected for recommendation, but the surveys are not sufficiently complete to admit of trustworthy estimates, and irrigation being a new industry in the Colony no financial forecast of any value can be formed. Colonel Home mentions many smaller projects by which the water supply of the country can be increased, but none of them seem to be such as would call for intervention on the part of the Government.

Among the minor sources of supply is that from artesian wells. It is interesting to learn that considerable progress of late has been made in this direction both by Government and private agency. The tract in which a flow of artesian water has been obtained covers 14 square degrees. Up to the present, approximately 154 bores have been sunk to a total depth of 209,000ft., and a supply of 60½ million gallons per diem has resulted. In view of irrigation from this source the report says that the bores have an average depth of 1552ft., and cost at the rate of £1 15s. 6d. per foot, so that thus a water-rate of 8s. 5d. per acre per annum would be required to cover the interest. The map of the drainage areas of the New South Wales river systems, which accompanies the report, has evidently been reduced from a very fine chart of the Colony, but its reduction to a scale of 35 miles to the inch has rendered it very confusing and indistinct, and much of the printing can be read only with the aid of a glass of high magnifying power.

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### SHORT NOTICE.

*Tourist Guide to the Continent.* Published by the Great Eastern Railway Company. Price 6d.—Among its fresh features are particulars of the new express service to Norway, Denmark, and Sweden, *vid* the Royal Mail Harwich-Hook of Holland route; a series of continental maps, a chapter upon "Cycling Routes in Holland, Belgium, and Germany," and a chapter, "Dull Useful Information," giving particulars as to the cost of continental travel.

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### *BOOKS RECEIVED.*

*Railway Management at Stations.* By E. B. Ivatts. Third edition. London: McCorquodale and Co., Limited. 1898. Price 6s. net.

*Memoires et compte rendu des Travaux de la Société des Ingénieurs Civils de France: Cinquantenaire*, 1848—98. Vols. i. and ii. Paris: Hotel de la Société, 19, Rue Blanch.

*Leçons Elémentaires d'Acoustique et d'Optique: à l'usage des Candidats au Certificat d'Etudes Physiques, Chimiques, et Naturelles* (P. C. N.). Un volume in-8 avec 205 figures. 1898. By Fabry (Ch.). 7f. 50c. Librairie Gauthier-Villars et Fils: Quai des Grands-Augustins, 55, à Paris.

*Etude Scientifique et Juridique sur les Combustions Spontanées, Réelles ou Supposées, Spécialement au Cours de Transports par Chemins de fer ou Maritimes. Faits, Théories, Expériences, Mesures de Précaution à Prendre Réglementation, Contestations, Jurisprudence.* Première partie: Etude Scientifique. Deuxième partie: Etude Juridique. Par E. Tabaries de Grandsaignes, Membre de la Société Chimique de Paris et de la Société Géologique de France, Avocat, Sous-Chef du Contentieux à la Compagnie des Chemins de fer de l'Ouest. Un volume grand in-8o. Prix, 7f. 50. Librairie Polytechnique: Baudry et Cie., éditeurs. Paris: Rue des Saints-Pères, 15. Liége: Rue de la Régence, 21.

## NEW MOTOR CARS AT THE PARIS SHOW.

THE display of self-propelled vehicles at the exhibition opened last week in the Tuileries Gardens, under the auspices of the Automobile Club de France, not only far exceeds in importance the shows of a similar character held in previous years, but is of interest as indicating the progress that has been made in the industry during the past twelve months on the other side of the Channel. Profiting by their experience of former shows, when a large number of vehicles was exhibited with motors entirely unsuitable for their propulsion, or even without any mechanism at all, the Committee of the Club insisted that all the motor cars intended for exhibition should go through a trial run from Paris to Versailles and back, so that visitors were assured that every vehicle on view was at least capable of being propelled by its own power. If there is much that is new in the show it cannot be said that makers have succeeded in striking out into entirely new lines. The progress is largely confined to improvements in existing motors, notably in the method of regulating the admission of the gas mixture into the cylinders. In the earlier types of cars the engines were arranged to run at a uniform speed, but it is found that a great deal of economy can be effected by reducing the quantity of gas entering the cylinders when a lower power is required, and this, moreover, gives a much greater latitude in the rate of travelling. With the gear arranged for four speeds, and the motor running at anything from 400 to 1200 revolutions, the speed of the carriage can be regulated with the greatest nicety. The carburizing of the spirit is generally done more satisfactorily than in the earlier vehicles, with the result that there is less smell and visible exhaust; but it is evident that considerable improvements will have to be carried out before these drawbacks are entirely overcome. Except in a few cases the systems of gearing employed have undergone very little change. The leading makers do not appear to give sufficient attention to this very important matter, or if they do the problem is one which they cannot easily solve. The spur-wheel gearing employed on most of the cars is bad for several reasons; it causes a lot of noise in changing from one speed to another, and unless the driver is particularly expert in dropping the wheels into one another the gear chips to pieces, when the metal often falls into the drum and gets worked up into the bearings. The leather belt has the advantage of smoothness of running, and would undoubtedly be one of the most satisfactory methods of power transmission if it were not so liable to stretch and slip. In the Mors vehicles it is claimed that this has been overcome by employing a *tendeur* worked by a lever which tightens the belt when it shows a tendency to run loose. One of the newest forms of transmission gear is that used on the Lepape car. In the first vehicles constructed by M. Lepape the power was transmitted by friction plates working at right angles to each other, but though this gave excellent results so far as the smoothness of running and the facility of changing the speed were concerned, the system had the drawback of rapidly wearing out the plates. It has now been superseded by another, in which the crank shaft is geared on to the countershaft by means of pulleys and leather cords, and the power is transmitted from the countershaft to the rear driving axle by a leather belt running on cones. We were informed that this system had been adopted after thorough experiments with all the known methods of power transmission. In this carriage the two-cylinder vertical motor is cooled by the circulation of the air. The cylinders are cast with ailettes or wings, and have an air jacket through which a blast is created by the expulsion of the exhaust from the "silencer." Though the motor runs at 1200 revolutions to develope 8-horse power—a rate which is rarely maintained for more than a minute or two in climbing the hills—we are assured that the cooling arrangement is thoroughly efficient, though of course it would be totally inadequate without the forced draught and the placing of the motor in front of the carriage to receive a large volume of air. There are several other new spirit motors on view, most of them horizontal, and they are nearly all designed on much the same lines as the leading types of engines. The makers aim chiefly at securing a perfect equilibrium of the motor in order to suppress vibration; but otherwise there appears to be little real progress of late in the designing and arrangement of the mechanism, though compared with the vehicles exhibited at the previous shows a considerable advance has been made in the carrying out of small though important improvements.

The French are so wedded to the spirit motor that it is, perhaps, not surprising to find other systems of explosion engines conspicuous by their absence, with the exception of one motor running with heavy oils. In the Koch carriage the horizontal motor is placed transversely, as is done in the Gautier-Wehrlé vehicles, and the two cylinders are in the same axis. The ordinary petroleum oil is sprayed into the cylinders and mixed with air as the pistons come together, and is then exploded by a firing tube when the pistons are forced apart. The motor runs at 600 revolutions, and developes 6-horse power. The consumption is about a pint of ordinary petroleum per horse-power per hour. Apart from the self-propelled vehicles, there were two or three new systems of motor attachments for ordinary carriages. The Amiot fore-carriage may be bolted to any kind of vehicle, and the tractive effort is exerted on the rear axle by means of a bar, while the front wheels are both driving and steering. The power is transmitted to the driving wheels by a flexible shaft. The carriage is suspended by a double series of springs, so that there is claimed to be absolutely no vibration in the vehicle itself. The new fore-carriage of MM. Brulé et Cie. is built on a circular underframe pivoted under the footboard. It carries a powerful two-cylinder horizontal motor, fired electrically, and is geared by spur wheels. The system is no doubt a good one so far as the power of the motor and its application are concerned, but it appears to be too heavy and cumbrous for a road carriage.

Steam was very poorly represented at the exhibition. De Dion et Bouton showed one of their steam omnibuses and a large steam brake, but the only light carriage propelled by this power was that exhibited by the Société des Generateurs Serpollet. M. Serpollet has for some time past been perfecting his carriage, and now claims to have secured the best results. He has had to solve several difficult problems, notably in accurately adjusting the proportion of petroleum admitted to the burners to the water forced into the tubes. If only a small amount of water be pumped into the generator, and the burners are in full blast, the tubes are liable to become damaged, and it is therefore necessary to regulate the heat of the burners with the quantity of water to be vaporised. This is accomplished in a very ingenious manner by a pump having two valves, one for the water and the other for the petroleum, of sizes exactly corresponding to the quantities of water and petroleum required to get the best economical results, and prevent the burning of the tubes. The power is regulated by pumping more or less water and petroleum into the tubes and generator, the proportion between them being always the same. The generator is rectangular in form and very compact, and fits into the back of the carriage. The horizontal engine of 4-horse power has two cylinders in the same axis, and is geared direct on to the rear driving axle. A series of tubes is placed longitudinally underneath the carriage to condense the steam. The vehicle is driven in much the same way as the Serpollet tramcars; that is to say, the water is pumped into the tubes by a hand lever at the start, and this hand pump is operated whenever it is necessary to get up high pressure to mount steep gradients.

Electricity is coming rapidly to the front for the propulsion of road vehicles, and is bound to make much greater headway as the result of the recent successful cab trials. All the cabs taking part in these trials were exhibited. The Jeantaud hansom cab secured the first prize in the category of vehicles for two passengers, and the second prize went to the Jenatzy cab of the Compagnie des Transports Automobiles. The Société des Voitures Electriques Kriéger was awarded the first prize in the class of cabs carrying four passengers. All the Kriéger cabs were sold at the show, and some good orders were taken by the other electric carriage builders. Mildé et Cie. exhibited an electric Victoria and a large electric goods-delivery van, which had been built for a company in course of formation for hiring these vehicles out to tradesmen. The Paris Cab Company had on view a cab with Tudor rapid-charging accumulators, and another on the Bersey system, this latter system being said to be preferable on account of the facility of removing the batteries, which are slung underneath the cab instead of being placed in the body of the vehicles, as in the French carriages. Some electric cars were also exhibited by the Pope Manufacturing Company, of Hartford, United States. The prices of the electric carriages are very high, ranging from £800 to £1000, but as they have proved their superiority for town use there is no doubt that they will be making considerable headway in the early future, and in view of the encouragement that is being given to the invention of suitable accumulators there is hope that before long something will be done to increase their efficiency, at the same time, perhaps, that their first cost will be reduced. From a business point of view the show has been entirely successful. A large number of English buyers have been present, and have placed numerous orders for petroleum vehicles, but it is hardly to be expected that they will get delivery for a long time to come, since among the scores of makers exhibiting at the show there are probably not a dozen who are at present able to build carriages on a large scale.

## DOCKYARD NOTES.

THE Marshal Deodoro, Brazilian coast defence ironclad, has been launched with considerable pomp and ceremony at La Seyne. Apparently the French are not used to launches on the scale usually assumed by the operation with us, since the current issue of *Le Yacht*, a paper greatly given to brevity, devotes the best part of a whole page to a description of the event. This description is called a "summary," but it is long enough to crowd out all description of the ship herself. The Deodoro and her sister ship Floriano are small ironclads of only 3162 tons, barely one-fifth the size of our battleships, and, so far as we should be concerned, not one-tenth as useful. None the less, they are good little ships, likely to be of great service to Brazil—if that nation ever gets them. They were recently reported to have been purchased by some Power—probably Japan—but this appears to be a *canard*. The Deodoro was in a very advanced state at the time of her launch, the turrets and sponsons being already on board. The armament will consist of two 9·4in., four 4·7in. quick-firers, four 6-pounders, some 1-pounders, and two 5·9in. howitzers mounted amidships, for possible use in bombardments. There are two submerged torpedo tubes. The armour is 14in. Harvey on the complete belt, and about 9in. on the turrets. She is proof against the 9·4in. gun, except at close range. The estimated horse-power is 3400, with a speed of 15 knots. The coal supply is 236 tons. Such, at least, are the figures given in "Brassey." It is a little hard to credit them all. The ship is more or less a French edition of the Harald Haarfagre, built at Elswick for Norway. The Norwegian ship has 400 tons more displacement, 300 more horse-power, 3ft. more draught—16·6ft. instead of 13·6ft.—a belt of 7in. and 8in. on the gun houses. The Elswick ship has two 8in. guns, six 4·7in. quick-firers, and six 12-pounders. Her trial speed is 17·2 knots. Now Elswick is second to none in getting the maximum out of a given displacement, and the apparent inferiority here is a curious matter. Probably the French ship has only got 14in. armour on a very small portion of the belt, more probably still the thickness is considerably less. She is devoid of the turret bases that the Elswick ship has—an important thing—but the figures, as given, cannot be accepted without reservation.

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THE Russians have constructed a copy of the Sokol at Abo. It is of 250 tons displacement, 4500-horse power, and 30-knot speed.

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THE new French ironclad Charlemagne appears to be a success. With all boilers lit and her three engines going full power, she developed 11,460-horse power, with 120 revolutions. The speed was 17·25 knots—natural draught. The French claim that she can maintain this speed at sea, and are very satisfied with the result; but French ships have somehow a knack of losing speed at sea. With forced draught she developed 14,500-horse power, and a trifle over 18 knots. We doubt, however, whether the ship would be a match for our Majestic. In the Charlemagne the big guns are in pairs, but the secondary armament, though isolated, is not so well protected. It is worthy of note that in the design for their newest ships, the French are going back to the old single-gun position. Elswick, in the O'Higgins, adopted this single-gun position. We may yet see it in the English Navy. Now that the improved Harveyised system makes 8in. armour do the work of 20in., there should be no insuperable difficulties. Where battleships are concerned the future is, according to some authorities, more likely to rest with the big gun than with the quick-firer; huge areas can be protected against that, but protection against the big gun is very difficult to secure.

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IT is officially stated that the Great Central Railway Company has decided to open the new line to London for coal traffic on July 25th.

## LATEST TYPES OF AMERICAN TRACTION ENGINES.

By WILLIAM FLETCHER.

(*Continued from page 548.*)

THE Aultman and Taylor Machinery Company, of Mansfield, Ohio, have recently introduced a compound traction engine, shown by Fig. 9. The cylinders are placed at the fire-box end, mounted on a box girder, which answers as an excellent water heater; the exhaust steam as it leaves the cylinder traverses the heater, and the water is pumped through the heater on its way to the boiler. Fig. 10 shows a section of the cylinders. Steam enters from the boiler at H below the valve, and does not enter the valve chest M until it is exhausted from the high-pressure cylinder. The valve has a cavity X, through which the steam passes to the small cylinder E D alternately through the ports K and L. The ports P O and N belong to the low-pressure cylinder. It is obvious that steam enters below the valve in its passage to the high-pressure cylinder. This entering steam has access only to a limited area, and tends to offset the pressure of the steam in the valve chest, which operates on the whole area of the valve. By this arrangement a simple balanced valve is obtained. The power is conveyed from the crank shaft by means of an inclined shaft, which reduces the number of parts and minimises the friction to its lowest point. One end of the inclined shaft receives its motion through bevel gearing from the crank shaft in the drum end of the bevel wheel; at the top of the inclined shaft a neat friction clutch is placed. The lower end of the shaft gears into a large bevel wheel, in which revolve the three compensating gear pinions, these pinions gear with small bevel wheels, one of which is bolted to the right-hand side main driving wheel, and the other is keyed to the axle, and thus drives the left-hand side travelling wheel. The makers contend that bevel gearing is the correct thing for the compensating apparatus. The Wolf patent valve gear is not merely a reversing gear, but acts as an expansion regulator. By changing the angle of the guide the point of cut off can be varied to suit the work to be done, gaining the full benefits from the expansive force of the steam, and effecting a considerable economy thereby.

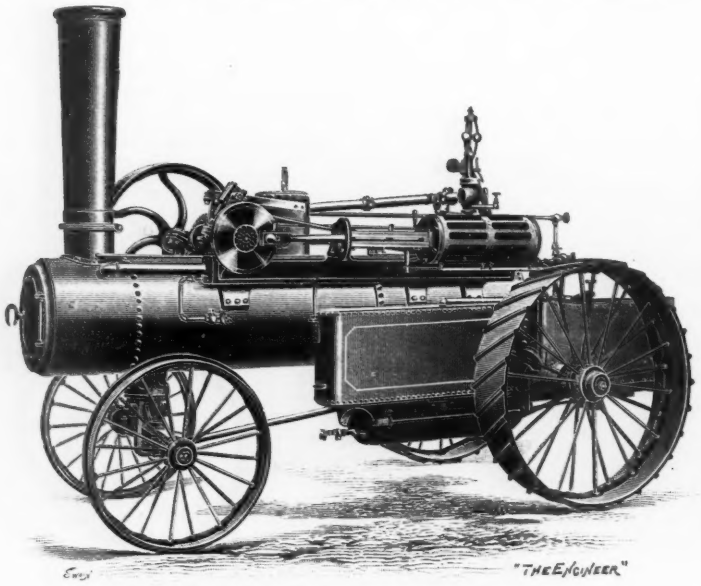


Fig. 9—AULTMAN AND TAYLOR'S COMPOUND TRACTION ENGINE

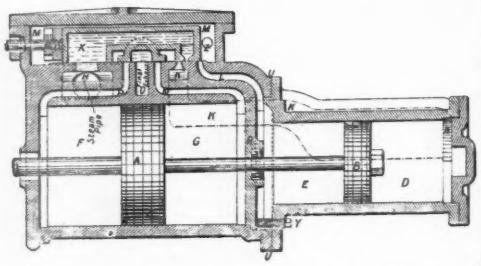


Fig. 10—AULTMAN AND TAYLOR'S CYLINDERS

It will be seen from Fig. 9 that the boiler has an extended smoke-box with baffle plate, which effectively increases the draught and reduces the back pressure. The water tank is neatly arranged on the left-hand side of the fire-box. The platform is nicely arranged; a coal-box on one side, and a tool-box on the other, form a guard for the driver. Some of the footplates in other engines appear to be small, and afford little or no protection to the engine driver.

Messrs. Aultman and Taylor have some very large shops, and it is of interest to learn that no boys are employed by them, but only the best mechanics that can be obtained. The boilers are tested by hydraulic pressure to 150 lb. per square inch. After the engine has been mounted on the boiler a steam test is made at a pressure of 120 lb. per square inch. The engines are made to develope on the brake twice their rated power.

The traction engines manufactured by the Harrison Machine Works, Belleville, Illinois, are fitted with two travelling speeds. There are times when the full strength of the engine is needed; for instance, when hauling a load over soft ground or up steep inclines, and this extra hauling power is obtained by the use of a small pinion on the main shaft; when this slow gear is used the engine travels at the rate of 2½ miles an hour. This slow speed may not often be needed, but when occasion requires its use it will be appreciated. Ordinarily the large pinion is used, and with it the engine has ample power to draw the outfit over roads and fields at a speed of from four to five miles per hour. The change from one speed to another is effected by a neat device. The driving wheels of the Jumbo traction engines are of unusually large diameter, the advantage of which goes without saying; a large internal spur ring secured near the periphery of each wheel is driven by a pinion on each end of the counter-shaft. It is very evident that this traction engine is a good road engine. The throttle and reversing motion are easily manipulated, both while in the field and on the road; the Jumbo climbs some hills over which it is impossible to drive an ordinary two-horse wagon.

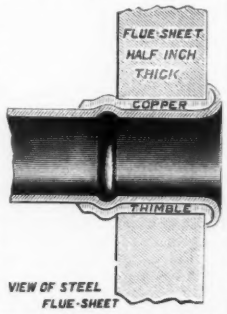


Fig. 12—NICHOLS AND SHEPARD'S COPPER FERRULE

The standard type of traction engine made by the Nichols and Shepard Company, of Battle Creek, Michigan, is shown by Fig. 11. The boiler is of extra strength, double riveted, where the severest strains are met with. A good form of copper thimble, as shown by Fig. 12, is used for securing the boiler tubes at the fire-box end. From the illustration it will be seen that the engine is secured to a neat form of water heater, the cylinder placed at the fire-box end, and the crank disc at the smoke-box end. The main axle is placed about the centre of the fire-box; the method of mounting the engine on springs is nicely carried out, as shown by the illustration; the rear axle is square, forming a good seat for the spiral springs, which are kept in place by a neat bracket. Over the square axle a sleeve is placed for the hind road wheel to run on, as shown by Figs. 13, 14, 15. The traction gearing is specially strong, and the pinions are made of steel.

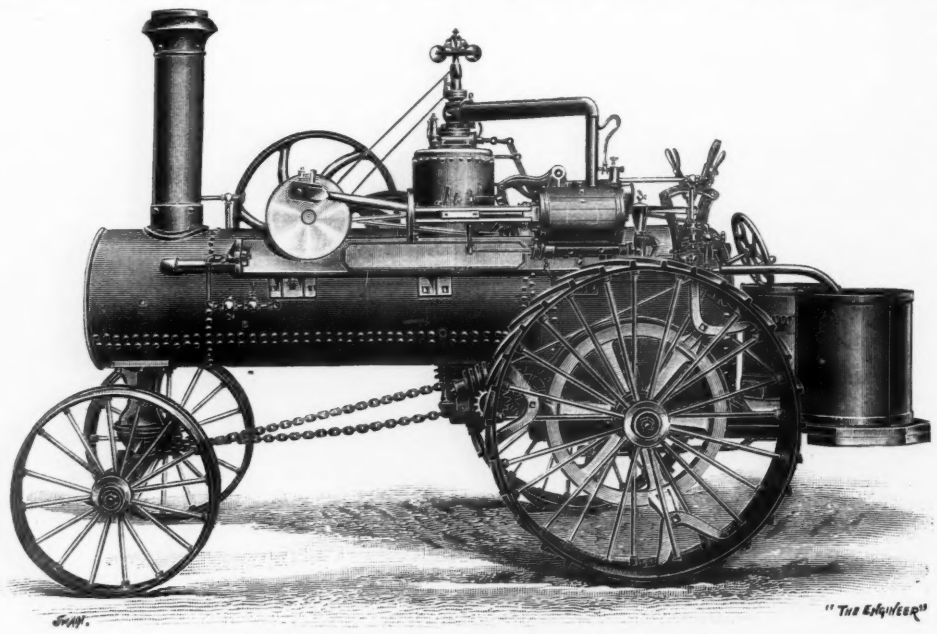


Fig. 11—NICHOLS AND SHEPARD'S TRACTION ENGINE

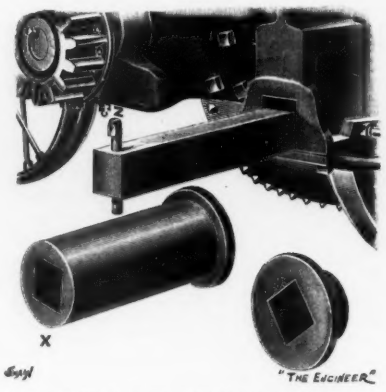


Fig. 14—NICHOLS AND SHEPARD'S MOUNTING

The Nichols-Shepard 13-horse traction engine, when running 225 revolutions of the crank shaft, the engine travels at $2\frac{4}{16}$ miles per hour. Weight of this engine in working trim is 11,500 lb. The engine will haul 20 tons on smooth hard roads, working at 125 lb. pressure per square inch, steaming easily with this load. The compound traction engine made by this firm is neatly arranged, has an extended smoke-box, with the leading wheels placed well forward.

Few firms make so many sizes and types of engines as Pitts' Agricultural Works, Buffalo. Fig. 16 shows a very neat direct flue wood or coal burning traction engine, with bored guide and side crank. The cylinder and crank shaft bearing are each mounted on opposite ends of a water heater, thus avoiding disturbances of working parts by the expansion and contraction of the boiler. The engine is mounted on wrought steel wheels with malleable iron lugs. Fig. 17 represents a standard return flue or straw-burning engine, used throughout the prairie region, and in South America, where fuel is scarce.

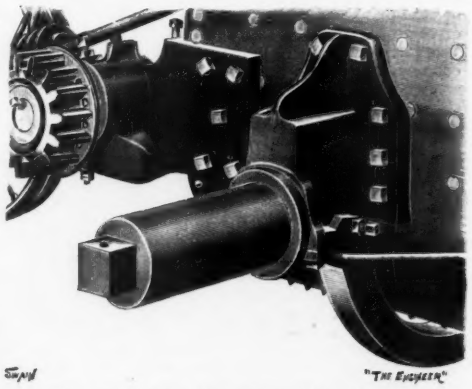


Fig. 15—NICHOLS AND SHEPARD'S MOUNTING

Fig. 18 shows another large size engine, with return flue boiler for straw burning; this engine is mounted on three wheels, and, like all Messrs. Pitts' larger sizes of traction engine, is made with a centre crank; the detail drawing, Fig. 19, shows the centre crank and the Woolf patent reverse valve gear. Its construction is simple, substantial, and admirably answers for reversing the engine and for varying at will the travel of the valve, so as to vary the point of cut off. Further on are given some dimensions of Buffalo Pitts' celebrated traction engines; many points of great interest in these engines have been passed over without remark for want of space.

The Port Huron Engine and Thresher Company's catalogue teems with valuable information for the thresherman as well as for the engineer. Full particulars are given to enable anyone to test the strength of the boiler in every part.

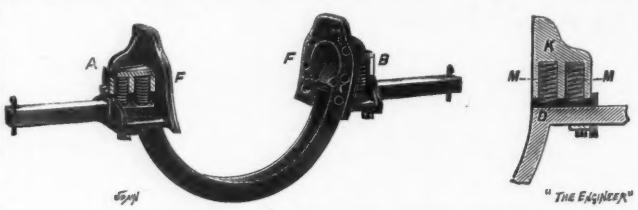


Fig. 13—NICHOLS AND SHEPARD'S SPRING MOUNTING

Fig. 20 shows the fly-wheel side of the Port Huron traction engine. The cylinder is fitted with a balanced piston valve with self-expanding rings. Some important tests have been carried out with the Grisse valve motion, which have proved the device to be more advantageous than the ordinary link motion reversing gear. The saving in fuel, or the gain in power by the use of the piston valve, in the place of an ordinary unbalanced slide valve, has resulted in $1\frac{1}{2}$-horse net. The distribution of

the weight on the wheels causes the engine to draw heavy loads without rearing; the engine is slow geared; when the fly-wheel runs at 220 revolutions per minute the drivers revolve, so as to cause the engine to travel on the road a little faster than a good team naturally walks. If faster travelling is desired the engine may be run at 300 revolutions per minute with safety. The platform is hung on springs. It will be seen from the illustrations that an extension smoke-box is adopted, which is a perfect spark arrester. The boiler is subjected to a cold-water pressure of 225 lb. per square inch, and a steam test pressure of 150 lb. to 170 lb. A dry pipe is used for conducting the steam from the top of the dome to the cylinder. The Port Huron is undoubtedly a high-grade traction engine; is economical in steam, strong and good in all its details, and possesses some advantages that will be appreciated by threshermen.

Ingleton's automatic track for use with all kinds of traction engines is shown by Fig. 21. By referring to the illustration it will be seen that the track can be made to rise from the ground automatically with the steering of the engine, so that in making a short curve with the engine, the track is thrown out of operation, allowing it to turn as easily and with the same freedom as if the track were not there. Many tracks have been tried, some have answered fairly well, but the great difficulty to overcome in most of the devices was the turning of the engine within a reasonable radius. This was found impossible, hence the value of the above arrangement.

The Springfield traction engine made by O. S. Kelly Company possesses many points of merit. The style of construction has much to recommend it. The hind axle and counter-shaft are placed at the rear of the fire-box, as shown in the illustration—Fig. 22. Only four spur wheels are used to transmit the power from the crank shaft to the hind axle. The compensating gear is placed on the axle; it is composed of bevel wheels in the usual manner. By an improved elastic connection the driving gear is relieved of all strain, and prevents the possibility of breaking any of the cogs. This gear is shown by Fig. 23. It will be seen that the only connection between the outer circle D and the arms F is through the six steel springs. Three of these springs are compressed in a forward movement, and three in a backward motion, E represents the cast trunnions, which rest loosely in sockets. The driving wheels are constructed chiefly of wrought iron.

The cylinder, slides, bed-plate, and pillow block are all separate and interchangeable; the slides are made of best cold rolled steel. A spring under the front of the engine makes it easy to steer. The boiler being entirely independent of the traction gearing, is used only to furnish steam—its legitimate function—and not as a support for the gearing. The Springfield traction engine is undoubtedly very powerful; it never rears in front, no matter how heavy the load happens to be. It will draw the whole rig up steep inclines at 2¼ miles an hour, and has taken the machinery up difficult places wherever a team can be employed. The good arrangement of the axle and the gearing accounts for the engine being a first-class hauling engine; the whole weight of the engine is in front of the axle, which effectually prevents rearing; an engine cannot pull a load if the front wheels have little weight on them and leave the ground. To prevent rearing some makers introduce some devices of a doubtful character.

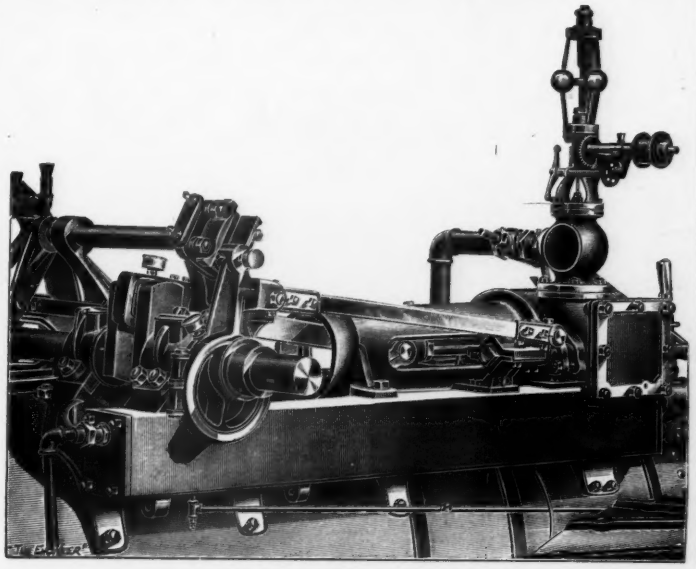

Fig. 19—PITT'S CENTRE CRANK ENGINE

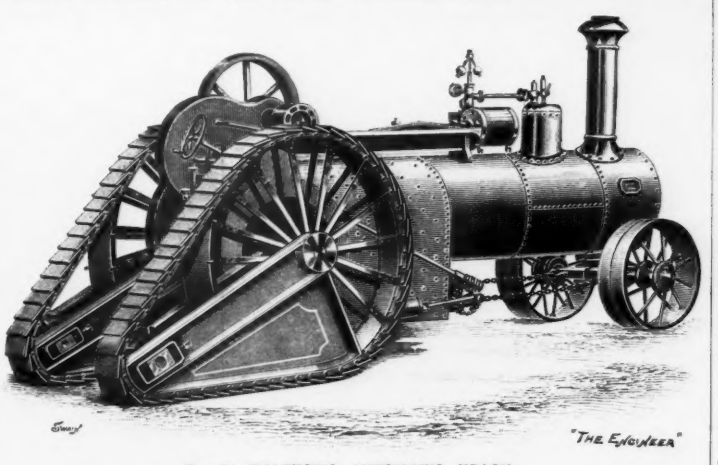

Fig 21—INGLETON'S AUTOMATIC TRACK

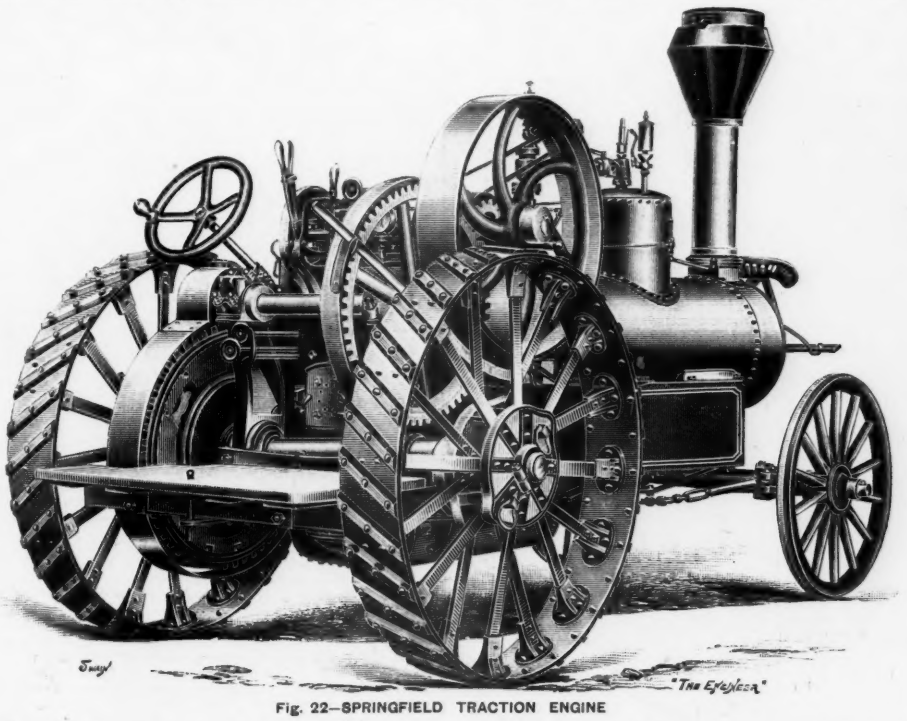

Fig. 22—SPRINGFIELD TRACTION ENGINE

The Minneapolis Threshing Machine Company is entitled to special mention as manufacturers of first-class traction engines. Fig. 24 shows an engraving of their compound engine, with full cab covering the entire engine. The fly-wheel side of the same engine is represented by Fig. 25. Threshing machines have been increased in size and capacity, the addition of self-feeders, weighers and wind stackers, have necessitated more engine power. To provide additional power without the necessity of furnishing engines too heavy for country bridges and soft ground, the compound engine has been introduced. The compound engine does its work easily with the same steam pressure used in the simple engine, and it is a more powerful motor. At any pressure from 100 lb. to 125 lb., it will furnish 3 or 4-horse power more from the same amount of steam, fuel, and water, than the best single engine under similar circumstances. The engine is mounted on a cylindrical return flue boiler, the same boiler with modified furnace being used for coal, wood, or straw. A superheating pipe is used for drying the steam before it enters the cylinder. The driving wheels are made of steel, with broad tires and high malleable mud cleats, as shown in the illustrations.

The Minneapolis traction engines occupy a good position for economy in fuel, safety, durability, and simplicity. Some particulars of the trials carried out with a traction engine of this manufacture at the World's Fair may be of interest:—"In moving, the engine hauled the tank wagon with an eight-barrel tank of water, a supply of fuel, the separator, feeder, and bagger, across a field to the road, accomplishing it without any apparent effort, travelling at the rate of four miles an hour. We witnessed a test of the Minneapolis traction engine with heavy loads. The engine hauled at one load six traction engines weighing 30 tons. This load it drew over two railroad tracks, ascending quite an incline, over rough roads, and making several sharp curves. This remarkable performance constituted a most severe and thorough test, and demonstrated to satisfaction the superiority of the Minneapolis traction engine."

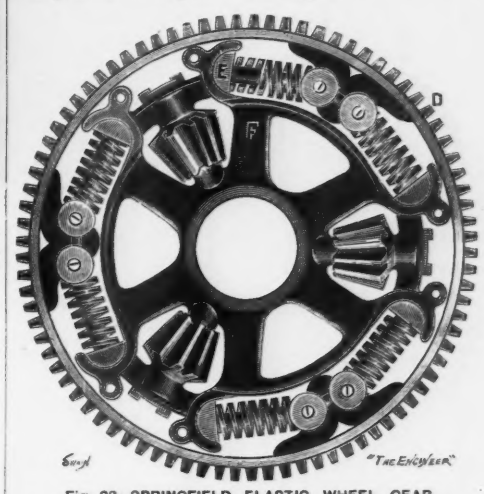

Fig. 23—SPRINGFIELD ELASTIC WHEEL GEAR

There follows a table—p. 18—of dimensions of eight American coal-burning traction engines of practically the same rated horse-power, and the dimensions of one English traction engine is also added of similar proportions. The actual horse-power must be taken as approximate only, as we have not sufficient particulars given by the makers to enable us to calculate exactly what each engine would develope by the friction brake on the fly-wheel.

A small table showing the water and coal consumption of four single-cylinder traction engines is also given.

| Name of maker | Advance. | Huber. | Foden. | Several English makers. |
|---|---|---|---|---|
| Water per B.H.P per hour | 34·5 | 32·04 | 25·63 | 27·0 |
| Coal per B.H.P. per hour | 5·0 | 5·32 | 2·53 | 3·3 |

The first two columns are taken from the makers' catalogues, the second column shows the results of trials at the World's Fair. The third column represents the figures obtained during some exhaustive trials at the Newcastle show of the Royal Agricultural Society of England.

The fourth column shows the results repeatedly obtained when thrashing under favourable conditions with the best English traction engines, having steam-jacketed cylinders, carefully proportioned and lagged boilers producing dry steam, fitted with a feed-water heater, and the link motion notched up for producing an early cut-off.

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NAVAL ENGINEER APPOINTMENTS.—The following appointments have been made at the Admiralty:—Fleet engineers: Benjamin J. Barnes, to the Victory, for reserve; James Leighton, to the Victory, additional for the Sultan; Frederick A. Cocks, to the Blake. Staff engineer: Thomas Thorne, to the Nile. Chief engineer: Henry Humphreys, to the Pembroke, additional for the Speedy. Engineers: Victor E. Snook, to the Wildfire, additional, for the Landrail; Ernest Barr, to the Victory, for the Conflict; Frederick G. Jacobs, to the Mars; and Henry A. Madge, to the Severn, for the Onyx. Assistant engineer: F. Guyer, to the Alecto. Artificer: H. E. G. Apps, to the Severn, for the Onyx.

TRADE AND BUSINESS ANNOUNCEMENTS. — The Wheeler Condenser and Engineering Company ask us to say that they have moved into larger premises at 179, Queen Victoria-street, E.C.—The Central Cyclone Company, Limited, sold to the United Alkali Company, Limited, machines at the Birmingham Show.—Messrs. Booth and Ravenshaw inform us that the partnership hitherto existing between them terminated on June 25th. They will respectively continue to carry on the separate departments of their business at the same address, 110, Cannon-street.—Messrs. Hodges and Co., late of Stoke Newington, inform us that they have removed to new works at Dunstable with greatly increased manufacturing and railway facilities.—The Klein Engineering Company, Limited, has taken over the engineering department of Mr. F. R. Putz, Manchester, and will carry on the manufacture of condensing plants, water coolers, &c. Head office, 9, South Parade, Deansgate, Manchester.

REFUSE DESTRUCTOR AND ELECTRIC LIGHTING IN LAMBETH.—The South London Electric Supply Corporation, who some time ago acquired the Lambeth Electric Lighting Provisional Order, entered into an agreement with the Lambeth Vestry to erect a refuse destructor in conjunction with the projected electric light station. The Corporation has now submitted to the Vestry for approval plans of the destructor which is proposed to be constructed by Messrs. Manlove, Alliott, and Co. in Bengeworth-road, Loughborough Junction. As the agreement provided that the destructor should be "of the most approved sanitary type," the Vestry were referred to that at Shoreditch, constructed by the same company. The Shoreditch destructor has been inspected by a Committee appointed by the local authority, who report that it appears to be most efficient, and as a result of the examination and report the Vestry has decided to approve the plans submitted on behalf of Messrs. Manlove, Alliott, and Co.

# LATEST TYPES OF AMERICAN TRACTION ENGINES

(*For description see page* 17.)

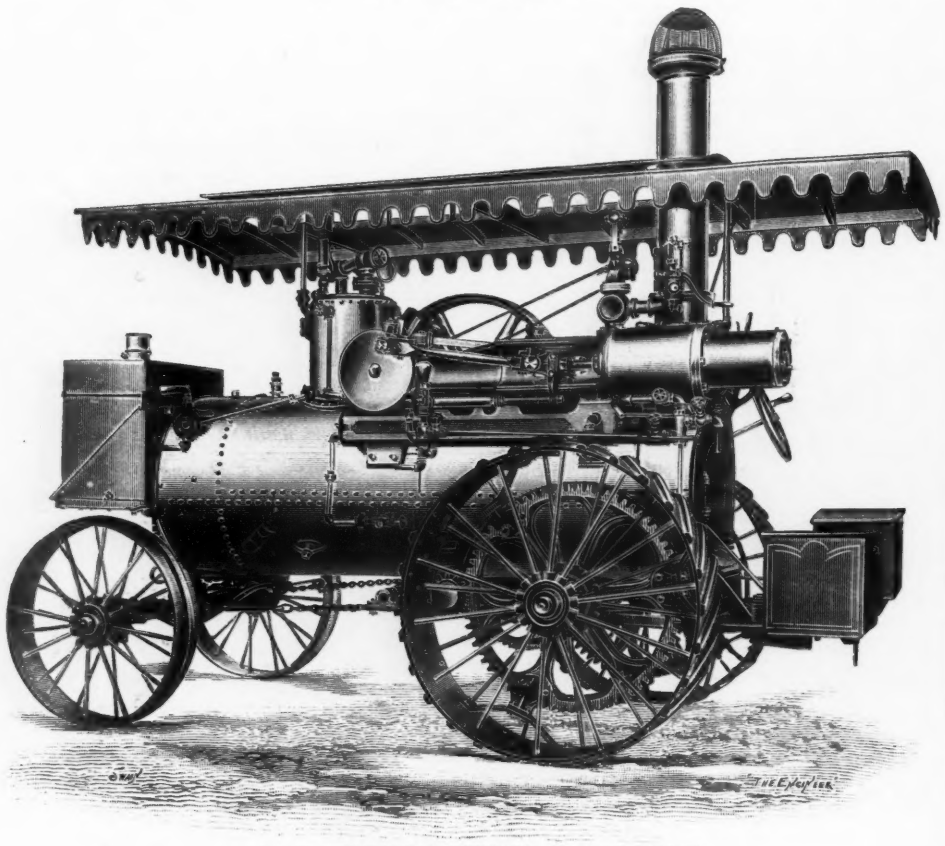

Fig. 24—MINNEAPOLIS COMPOUND TRACTION ENGINE

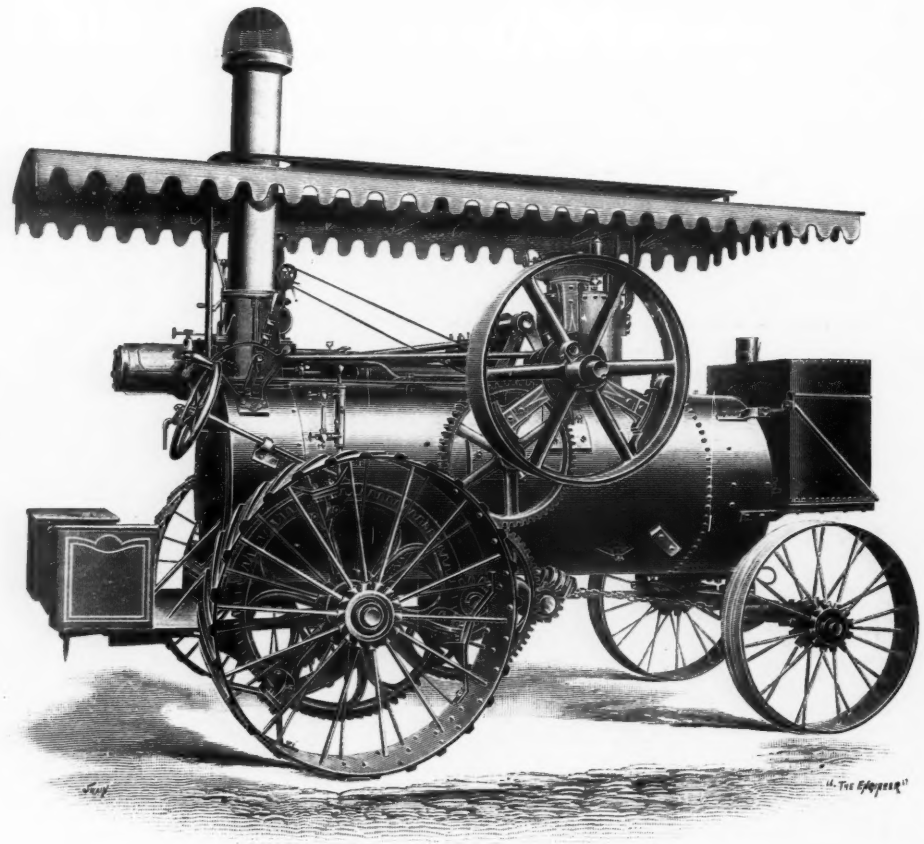

Fig. 25—MINNEAPOLIS COMPOUND TRACTION ENGINE

*Table of Dimensions of American Traction Engines.*

| Name of Maker | Advance. | Pitts. | Jumbo. | Gaar Scott. | Pt. Huron. | Minneapolis. | Stevens. | English maker. | Case. |
|---|---|---|---|---|---|---|---|---|---|
| Rated horse-power | 16 | 15 | 16 | 16 | 16 | 16 | 16 | 7 | 16 |
| Actual horse-power | 80 | — | — | 38 | 31 | 33 | 32 | 30 | — |
| Diameter of cylinder, in. | 8½ | 8½ | 8½ | 8¼ | 8 | 8 | 8¼ | 8½ | 8¼ |
| Length of stroke, in. | 10 | 10 | 12 | 11 | 10 | 11 | 10½ | 12 | 10 |
| Working pressure, lb. | 100 | — | — | 110 | 120 | 120 | 120 | 140 | — |
| Hydraulic test press | — | — | — | — | 225 | 185 | — | 240 | — |
| Diameter of boiler, in. | 29½ | 30 | 30 | 32 | 30½ | 40 | 28 | 32 | 29 |
| Width of fire-box, in. | 24 | 25 | 25 | — | 26 | — | 24 | 24 | 24 |
| Length of fire-box, in. | 42 | 40 | 40 | — | 44 | — | 39 | 33 | 40 |
| Number of tubes | 24 | 41 | 32 | — | 46 | 26 | 48 | 34 | 41 |
| Diameter of tubes, in. | 2¼ | 2 | 2½ | — | 2 | 2½ | 2 | 2¼ | 2 |
| Length of tubes, in. | 93 | 72 | 78 | — | 72 | 88 | 72 | 72 | 96 |
| Fly-wheel sizes, in. | 40 × 10½ | 40 × 8½ | — | 38 × | 40 × 10¼ | 42 × 8 | 40 × 9½ | 54 × 6½ | 36 × 9 |
| Driving wheels, in. | 66 × 18 | 66 × 16 | — | 62 × 14 | 66 × 16 | 56 × 16 | 60 × 16 | 69 × 16 | 66 × 16 |
| Revolutions per minute | 225 | 210 | — | 221 | 220 | 225 | 220 | 160 | 250 |
| Speed on road, slow | — | — | 2½ | — | 2½ | — | — | 3 | — |
| Speed on road, fast | — | — | 4 | — | — | — | 4½ | 5 | — |

## LETTERS TO THE EDITOR.

(*We do not hold ourselves responsible for the opinions of our correspondents.*)

### THE BALANCING OF ENGINES.

SIR,—In my letter last week I should have written a sentence in the penultimate paragraph thus:—"It follows from it that if a complete engine is 'balanced,' or designed, so that the common centre of gravity of all the parts in motion remain in fixed position relative to the frame, and also so that all resultant axes of gravity either remain thus fixed, or rotate in constant direction and speed, it will exert no force to vibrate its bed-plate." The alteration is necessary to make the statement applicable generally, and also to cover the vibratory effects of periodic variations in the rotative speed—to which, by the way, I devoted a brief section of my paper.

I have been re-reading Professor Smith's letter with a view to further reply, and I find that I put too narrow a construction upon some of his statements. I conclude now that he quarrels rather with the manner of my theorem that "steam stresses have nothing to do with the problem of balancing an engine" than with its obvious meaning. If I had added, "except in the way they order the motion," he would, I think, not have objected to it. My mode of thought is the practical one of regarding the influence of uneven rotation quite distinctly from the balance of the engine parts. For the effects have little in common, and constancy of rotation is usually sought after for quite other reasons than that of balance, and often so closely reached that its vibratory influence is not great. At the same time he would not have thought that I had lost sight of it if he had read my paper. This I say in concession to the broader definition of the word balancing. If I claim the narrow and common acceptance of the term in this connection, the theorem as first stated is in no need of qualification.

Professor Smith follows up my remark about "complete machines," and goes into a rather superfine discussion of what constitutes the completeness. But it does not greatly concern the practical aspects of our subject. In fact, the two cases, in which the balancing question is now of most moment, are direct-coupled dynamo engines and marine engines, in neither of which is the want of completeness anything but a very fine distinction. Moreover, any balanced engine, if it has a constant turning moment and works against constant resistance, will be free from vibration, however and whatever it drives. Uneven rotation may produce vibration through the inertia effects of the fly-wheel in a way I described in my paper; but "turning moment," and not "balance" pure and simple, is the dominating influence here, and this depends, of course, mostly on the number of points and directions at which the rotative effort is applied.

I am glad to see that Professor Smith has mentioned the vibratory influence arising from the presence of axle springs in locomotives. But for time, I intended to have referred to it in my paper, which was already too long. The effect is such that the varying downward pressure on the slides tends to raise the driving wheels from the rails and let them fall again, twice per revolution. It is only a small effect with long connecting-rods, and it only bears on this particular case. In most engines the interconnections of the parts are by design perfectly rigid, and "springy links" do not enter the argument. The point, in fact, only arises because the locomotive is not a complete machine apart from the rails; and the evil, which, if large, would be a difficult one to deal with, must be classed with other minor defects in locomotives that are productive of vibration, such as the uneven wear of wheels. The old system of inclining the cylinders was, as Professor Smith states, a serious mistake from this same point of view. But I reiterate that the circumstance that we are compelled for ulterior reasons to use springy links in a certain construction of incomplete engine, through the medium of which the steam pressure may be productive of vibration, does not vitiate the general theorem that steam stresses are not directly concerned in the balancing problem.

Professor Smith speaks of absorption of energy by the friction of the mechanism, and how it spoils the practical application of the law of equal action and reaction. But what, free of superfluous verbiage, is the actual bearing of this point on the question in hand? It is this, that any engine in which the absorption by friction were such as to significantly alter the stresses, would be rejected by the mechanician as too inefficient for practical use. Professor Smith knows this as well as the rest of us; and why he introduced the point to confuse an already too complex study I cannot conceive.

Besides, absorption does not influence the resultant vibratory effect. Like cushioning it modifies the bearing stresses, and no more. Therefore, the invincible fact remains that it is only resultant effects we have to deal with; which is the same grand truth that comes to us direct from purely mathematical considerations. Professor Smith, I am sure, has also realised this; therefore I take him to task for the superfine attitude he takes on this point. Paradox and plausible syllogisms flourish well enough without the quasi-support of his name and authority; and I hold that one should pause long before he gives it pretext, and generally unsettles plain men's minds by wrapping up simple truths in a mass of superfluous qualifications. I am sorry to have to speak thus emphatically. We are really so much of the same mind, that in the broadest sense we have no ground of variance. But I am strongly in earnest in wanting to free this subject of purely academic trammels. I want it intelligible to the busy mechanician as well as to the dreamy mathematician, and therefore I object to its being overburdened with metaphysics.

I shall leave "X." and Professor Smith to pursue alone the quibble raised as to the tangibility of Newton's third law. But as to the former's instance, I must again protest against belt effects being brought into the argument. There is nothing wonderful in the fact that the jerky transmission of power by a loose flapping belt will violently shake an engine; and it has nothing to do with our subject. Otherwise it is not to be supposed that a small vertical engine fixed to a heavy boiler would exhibit much vibration.

I see "X." does not grasp the meaning of synchronism in this connection. It is not a question of engines being in tune with foundations—the idea is absurd—but of engines being in tune with each other. Next as to the vibratory effects to be expected from different engines, it is necessary to remember that the inertia forces are proportional to $4\pi^2 n^2 c$, where $c$ is throw of crank, and $n$ the revolutions per second. That is, they are proportional to the piston speed multiplied by the revolutions, which shows how short-stroke engines are the more conspicuous in this respect. For with same piston speed, power, and weight of parts, there is double the inertia force acting in an engine running at double the revolutions of another. It is roughly, in fact, not so much a question of size and piston speed as of revolutions. Quick revolution means severe inertia stresses, alternating rapidly in direction. Hence the more significant vibration. To repeat his own polite remark, "If 'X.' will think the matter out, he will find that, after all," there are some very powerful forces to cause vibration in quick-revolution engines, since these, for commercial, mechanical, and thermal reasons, have also to be run at fairly high piston speeds.

Of Professor Smith's engine I have only a vague conception; and being condemned to the primitive civilisation of provincial towns, I have no ready means of reference regarding it. But I understand the principle of it comprises two counterweighted crank discs, rotated in opposite directions by two connecting-rods from the same crosshead. That is how it has been described to me; but if this is correct, it is not in perfect balance, for the connecting-rod effect remains unbalanced, which is readily apparent when we observe that, when the piston has travelled down half the stroke, the counterweights have not risen one-half. I should like to know how this has been corrected in the actual

design. If it has been left to take care of itself, Professor Smith must not blame the steam stresses for any difficulties experienced in realising "its perfect balance."

I must ask "Vauxhall" to again excuse me.

Nottingham, June 27th. JAMES WHITCHER.

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### THE ROYAL ENGINEERS.

SIR,—The Royal Engineers, the corps charged with army technical work generally, and including from the submarine miner to the railway traffic manager, from the balloonist to the mechanist, are still educated together, charged alike with a same set of professional duties of military engineers, and absolutely interchangeable from one position to another, by an attempt to treat them still as members of one profession, like before the applications of railways, machinery, electricity, and the modern developments of engineering to warfare.

The apparent withdrawal of the paragraph in the "Queen's Regulations for the Army," which used to mention certain duties as professional to all engineers alike, the keeping of a record of the various kinds of employment into which each officer has drifted during his career in an unorganised corps, and the withdrawal of part of the military engineer's education from the curriculum of officers destined for submarine miners—although there is no guarantee whatever that those officers will remain submarine miners, and though one of those subjects, permanent fortification, is one of the only ones of the military engineers' specialities which really would be useful to them—is absolutely all that has ever been done since the Royal Engineers have come to include many quite distinct professions to recognise the fact.

The wholesale waste of efficiency and misapplication of valuable education resulting of such a state of affairs is obvious enough; but the evils of the system are far from ending there, the greatest undoubtedly being some indirect ones.

As regards the corps itself. The Royal Engineers have now to furnish three quite distinct kinds of officers. Firstly, the military engineer proper, the normal officer of engineer companies, who, combining a thorough military training and knowledge with the qualifications of an engineer, designs fortifications and plans attacks on fortresses.

His companies, going into the field equipped with engineering plant and appliances, must in the emergencies of war be ready to turn themselves not only to the one kind of work, but to any that may be required at the moment. Their training, therefore, especially that of the officers, must be essentially a varied one, and which is, moreover, in every way that most suitable for an engineer of emergencies and expedients. Those companies are therefore combined, different as their special works may sometimes be, in one corps, under one corps of officers, who, exchanging constantly from one kind to another, and gaining experience in civil employment when possible, get the varied training necessary for them; to get which it is, moreover, clearly indispensable that they should be carefully relieved of any speciality additional to the many required of them—all the works that their troops with the tools they carry could execute.

Secondly, the officers of the newer kinds of engineer companies, equipped with special appliances for one special kind of work. This need for a generalised knowledge does not, therefore, apply to them any more than for the military engineer to extend his already too comprehensive list of knowledge to their work, which his troops are not, either, equipped to do; but so great are the advantages of versatility in all branches of an army, that troops of that kind have been combined in organisation and training with others of similar specialities, in countries where careful organisation of the scientific services has been carried out, as in Germany the coast artillery and submarine mining services.

The Artillery—a science which is an engineering one quite as much as others who have alone retained the name—was originally a branch of the Engineers. The necessity of separating it, being fitted for its one kind of work only, and therefore to be trained for it alone, was recognised long ago; but the identical necessity for separating the submarine miners from the military engineers has not been recognised yet in our service.

Thirdly, by the modern developments of engineering science and its application to war. A certain number to form a staff of officers who, contrarily to the military engineer proper, must specialise to manage railways, plan the railways, or other such engineering carried out, on large and more permanent scale on the lines of communication, or in exceptional circumstances in the front. These officers also have as little need, for their duties, of a very generalised knowledge, as the military engineer for the hasty and temporary works he would have to put up and repair under the very fire often of the enemy, has for a specialised knowledge, so constitute also an absolutely different class. These form also a list of officers, well trained as engineers, though less specially as military engineers, to draw on in cases where engineer companies are furnished with very large complements of officers, occasionally as many as ten per company, as they are sometimes for special work or in special circumstances. In such cases the luxury of some specialised officers among them becoming permissible, the normal complement of specially-trained military engineers, together with officers having specialised some kind of work the company is to be employed in, is a very excellent officering, quite independently of the economical necessities and of the fact that by not doing things so, and increasing the military engineers themselves to meet any such call, they become so numerous that with the always limited amount of engineering work available to train them on in peace time, few can get a sufficient training at all.

For this latter kind a very large proportion of the Royal Engineers as the present system works are very well trained, most of those in the Indian Public and Military Works Departments furnishing capable specialists and officers of great utility in engineer companies in perhaps all situations arising in uncivilised warfare. But with a corps of officers increased to 800—excluding colonels and officers under instruction—for whom there is never employment giving any real military engineering experience at all in peace for more than 250 at a time—including 170 with engineer companies, properly speaking, and some additional 70 in quasi-military employment affording military engineering experience; the whole of which corps being officially regarded as military engineers, a large proportion of them come in for some share of such experience, divided as they are among so many officers, and meagre as is often the experience they afford, no properly-trained adequate body of really military engineers is or can be trained among them, and the efficiency of the still most important branch is sacrificed.

By the mixture of these utterly different branches, officers are found in the one kind of employment who have spent some part of their service learning a work belonging to another, meaning, in such a case as the military engineers, to the inevitable sacrifice of some knowledge that really is essential to them; and a very large proportion of the education in military engineering is given to officers such as those of the second, and many of the third categories, who of all in the army have about the least opportunity of keeping up such knowledge in peace, or of applying it in war. This wholly avoidable sacrifice of efficiency is rendered the more serious by the fact that the value, the range of utility of engineer troops, varies in some degree directly as the attainments of their officers and their capability of putting them to different kinds of work as occasions might arise.

A thorough training, as well as education, in engineering is equally essential to engineers of all branches, but not attained or attainable with the undivided corps, regarded as a whole a corps of military engineers; for it has become too large for it to be possible to arrange for all its officers spending a fixed portion of their service in some department where they could get real engineering experience, so that the examination of the records of service of engineer officers will show, together with a number who are military engineers by name only, a number who are engineers at all by no better title.

So clear, however, has it become that the War-office is more inclined to endeavour to maintain unaltered an historic corps than to study seriously the best organisations of the Engineer services for national defence, that it is to the harm that the unorganised corps does without it that Royal Engineers who wish to see their service put into a workable shape look, in hope of seeing them cause some action to be taken in the matter. Not only are these evils more obvious, of more general interest, and incapable of being argued away with obsolete but deceptive arguments, such as those by which the corps of all science has been bolstered up so long, but they are really of far greater importance.

The undivided corps is the obstacle to the natural organisation of the engineer services by re-militarising the Imperial Branch of the Indian Public Works Department, the formation of which into a partly civil department has since been constantly condemned.

Its officers are singularly suited to be used as a military reserve, not only by the value of their professional attainments in every branch of the army, but by the fact that, with the exception of those employed on works in important connection with a military campaign, they are thrown wholesale out of their normal employment in war by the dearth of funds for public works.

Trained at Cooper's Hill as soldiers, whilst being educated as civil engineers, and posted on joining their department to native regiments, which they would join on active service and in peace time for manœuvres as occasion presented, they would form a highly valuable body of officers, not alone to supply engineer companies when a large number were mobilised with large complements of officers, but, with the present size of that department, the so much-needed reserve for the whole of the Indian Native Army.

On attaining field rank, when their inevitable lack of military experience would render advisable their withdrawal from higher regimental employment, they would form the staff of specialists of all kinds our army requires—one larger than theoretically necessary; but this is as it should be, as large numbers employed on railways leading to the front and such works would be wholly unavailable in time of war. The now partly military and partly civil Royal Engineers Department, increased as it would have to be if the Royal Engineers were reduced and similarly militarised, would form to the home service what the militarised Public Works Department would to the Indian.

But this could not be done without reducing the Royal Engineers to the number required as military engineers, for a normal complement of officers for all the engineer companies proper and for extra military engineering appointments. Then their training would present no difficulty, and few more than one-half being employed with their companies in peace time of the large proportion of officers which constitutes their normal complement for war, a large number could always be spared for training in civil employment. The undivided corps is thus responsible in a very direct way for the dangerously under-officered condition of the whole of the Indian Native Army. With the 800 engineer officers for whom there are in peace time but under 250 military appointments of any kind, a large number are never employed in commanding troops and in the duties of a soldier. By virtue of their nominal profession of military engineers, however, conferring on them combatant rank, these officers are all entitled to claim the command in the field whenever events may have made them senior on the spot.

The undivided corps, therefore, is responsible for the fact that in the British service no technical qualification beyond having been once educated in a military school is required to allow officers to take command of men and lead them in battle.

The Royal Engineers are the cause of the necessity, so expensive to the Indian Government, of maintaining separate military and Public Works Departments, and that whilst adding but very little to its defensive power, as compared with what the far less expensive wholly militarised engineering department would do.

Finally, they are the cause of constant grievance and injustice to the civil engineer of the Public Works Department, taking many of the most coveted appointments of their department, and doing with them the same work for much higher pay.

Seeing the grotesque impossibility of an undivided corps of all sciences treated as members of one profession, the grave anomalies it gives rise to in practice, and the example set by other Powers, whose engineer services, far less important relatively than ours, have all long ago been put in order, and more especially seeing the very limited utility as well as the hindered efficiency of this corps as compared with that of the Engineer service, we could have at a less cost by using available material and making necessary changes; this case should be exposed as perhaps the most remarkable instance available of the degree to which our military administrators lack in the capacity to see the necessity of a change, however obvious, or the courage to carry it out.

A ROYAL ENGINEER OFFICER,
Late of the Indian Public Works Department.

June 17th.

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### WORKMAN'S COMPENSATION ACT.

SIR,—Your Special Commissioner, in his article referring to our fund, speaks of my report as a private document. Allow me to say that any of your readers can have a copy by applying to Mr. J. Bush, the secretary to the company.

Our experience since the mutual fund was started in July last has been valuable, as showing certain unexpected and, to some extent, disappointing results, the chief being the extraordinary number of trivial claims on the fund. The report above referred to was written solely for the information of our workmen, who are almost to a man subscribers to the fund, I am glad to say, with a satisfactory result. The committee of workmen have agreed unanimously—the suggestion, in fact, was made by themselves—that the rate of payment ought to be reduced for all accidents that cause disablement not exceeding a fortnight from the Accident Fund pay of 18s. to the Sick Fund rate of 12s. a week, and they recommend that we should revert to the old system of making these minor accidents a charge upon that fund. This recommendation was made because a workman member said a definition of what is an accident was wanted, and this being found impracticable, they thought it best to fall back on the Sick Fund. They believe, and I think with reason, that many men who in the past twelve months have come on the Accident Fund for the 18s. a week would not come on the Sick Fund at all, or, if so, for a shorter time. This arrangement leaves the pay for all serious accidents at the higher rate. In the event of an accident supposed to be slight, turning out serious, there will be no difficulty in making up the 12s. to 18s., for the first two weeks. Let me sum it up in a sentence. Give as little as possible for trifling accidents, and deal as liberally as circumstances will permit with those of a serious nature.

In our case, even on the liberal provision for all accidents which has been in force during the last twelve months, the money cost is not serious. Including pensions of 10s. a week to the twelve surviving widows of all the men killed in the company's service, the total is about 1¾d. per week per man, or £1300, which on £320,000 paid in wages in the year is rather under 8s. per cent. To meet the claims under the Act not more than half, or 4s. per cent. on wages, or less than 1d. per week per man, would have been quite sufficient.

I hold that every industry ought to provide for its killed and wounded workers, and am, therefore, a supporter of the principle of the Act; but the best and only thoroughly satisfactory method is, I firmly believe, by means of a mutual fund to provide for all accidents. Where trade unions do not not tyrannically interfere with the free judgment of the workmen, our experience shows that they will readily unite with their employers to create and work a reasonably mutual arrangement. It is much better than insurance, which for many reasons seems to me the worst plan that can be adopted; better by far do nothing and take the risk of the Act, except, perhaps, where the number of men employed is small. For the small employer there seems to be no alternative to insurance, and seeing that it has been said that expenses, management, &c., absorb 40 per cent. of the premiums, the protest you have made against excessive premiums is most necessary.

I would point out to your correspondent "Factory Surgeon" that, if the Act did not exclude the first fortnight, the danger of which he speaks would be enormously increased. That first fortnight's exclusion is the salvation of the Act. Without it the door would have been opened, and a powerful inducement given, to all kinds of trivial and trumpery claims, both honest and dishonest. A man now will hesitate before going without pay for a fortnight, and it will not be worth his while, if he is able to return to work in the second week, to spin out the time in order to get no more than half-pay for a short time afterwards.

South Metropolitan Gas Company, GEORGE LIVESEY.
Old Kent-road, S.E., June 27th.

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### MAGNETISM AND THE SPECTRUM.

SIR,—My attention has been called to a note in the *Electrical Review* of June 10th, being a copy of a letter by Mr. Charles, of Bristol, appearing, I understand, in THE ENGINEER, with reference to magnetism being produced by the violet rays of the solar spectrum. In case Mr. Charles may not have obtained the information he desires, and being myself very interested in magnetism, it affords me much pleasure to draw his attention to the following. Humboldt in his "Cosmos," vol. v., page 64, published by Bohn in 1858, makes the following observations, viz.: A.D. 1812, "Morichini, of Rome, maintained that non-magnetised steel needles became magnetic by contact with the violet rays of light. Regarding the long contention excited by this assertion, and the ingenious experiments of Mrs. Somerville, together with the wholly negative results of Riess and Moser, see Sir David Brewster, 'Treatise on Magnetism,' 1837, page 48." ARTHUR G. COTTERILL.

Birmingham, June 28th.

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### THEORETICAL DYNAMICS.

SIR,—It is well known that if a billiard ball is struck high up with the cue it will follow the ball which it strikes full.

It is also known that if a ball is struck low down with the cue, it will not follow the ball which it strikes full, but will stop dead, transferring the whole of its energy to the ball which it strikes. Will any reader explain why?

I have asked many persons, but have never got a satisfactory explanation.

Am I right in assuming that in the former case the ball rotates faster than it rolls, so that it has positive slip on the cloth, just as a driving-wheel has on the rails; and that in the latter case it has negative slip on the cloth, revolving more slowly than it rolls? The hypothesis will explain what takes place, but I find it very difficult to believe the hypothesis, and I can find no evidence of such a thing in experiments made with marked balls. The whole question of "side" is very curious and interesting, as, for example, in base ball and cricket; but mine is not a question of "side." LOSING HAZARD.

June 27th.

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SIR,—If Mr. Lousley will read my letter again, he will see that he has not answered my question. I am, of course, aware that the weights are in theory equal, and the pull on the cord 10 lb.; but in practice, as I have said, I cannot get the arrangement to work. If I use 10 lb. counterweight, the whole affair comes quickly to rest. The friction is extremely small.

Furthermore, I am unable to understand how there can be a pull of 10 lb. in a cord uniting two bodies which are moving at the same pace. One must go faster or the other slower to tighten the cord. I suspect that this is the cause of the failure of my experiment. As an ordinary Attwood is not tall enough to carry out the experiment, I have worked over a well staircase.

June 23th. SECUTOR.

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## LAUNCHES AND TRIAL TRIPS.

THE s.s. Guernsey, which is the fortieth turret-deck vessel afloat, was launched from the yard of Messrs. William Doxford and Sons, Limited, of Sunderland, on June 21st. She is built to the order of Messrs. A. N. Hansen, and Co. of Copenhagen, who are the owners of the turret-deck steamer Norman Isles, which was built by the same firm in 1896. The dimensions of the Guernsey are 365ft. by 50ft. by 29ft.; deadweight capacity, 6800 tons: triple-compound engines; two boilers, 180 lb. working pressure, fitted with Howden's forced draught. On leaving the ways she was named by Mrs. Hans Nielson, of West Hartlepool.

On Thursday June 16th, the fine steel screw steamer Plencia, built by Sir Raylton Dixon and Co., Limited, Cleveland Dockyards, Middlesbrough, was taken out to sea for her official trials, under the command of Captain Alfredo Arcocha. She is built to Lloyd's highest class, her principal dimensions being:—Length, 299ft.; beam, 42ft.; depth moulded, 20ft. 3in.; and has a deadweight carrying capacity of about 3500 tons on a light draught of water. Triple-expansion engines have been fitted by Messrs. Blair and Co., Limited, of Stockton-on-Tees, having cylinders 22½in., 36½in., 60in., by 39in. stroke, with two large single-ended boilers working at 160 lb. pressure. Captain Ybarra, representing the owners, and a large number of friends were on board during the trial trip, which was highly successful, the vessel afterwards proceeding to the Tyne to load.

On Wednesday June 15th, the fine steel screw steamer Cardiff, built by Messrs. William Gray and Co., Limited, and owned by Messrs. W. G. Morel and Co., of Cardiff, was taken to sea for her official trip. She is of the following dimensions:—Length, 329ft.; breadth, 46ft.; and depth, 23ft. 6in. Her machinery is of the triple-expansion type, manufactured by the Central Marine Engine Works of the builders, the cylinders being 23in., 36½in., and 62in. in diameter, with a piston stroke of 39in., and steam is supplied by two large steel boilers working at a pressure of 160 lb. per square inch. After the usual manœuvring of the vessel for the adjustment of the compasses, several runs were made along the coast, the mean result of her performance being a speed of 11¼ knots. Mr. W. G. Morel, one of the owners, was present—this gentleman has also superintended the construction of the vessel and her machinery; Captain Murrell represented the shipbuilders, and Mr. James Lindsay the engine builders. On the conclusion of the trial the vessel at once proceeded to Hull, where she takes in a cargo of coal for Buenos Ayres.

On the 20th ult. there was launched from the shipbuilding yard of Messrs. D. and W. Henderson and Co., Partick, a large steel screw cargo steamer which they have constructed to the order of Messrs. Harris and Dixon, London, under the superintendence of Mr. H. M. Rogers, consulting engineer to the company. The vessel is in length between perpendiculars 375ft., breadth 50ft. with a depth of 28ft. 8in., having a gross tonnage of about 4400 tons, and will be classed in Lloyd's Register 100 A1 three-deck rule. She has been fitted with all the latest improvements to ensure the rapid and safe working of the large cargo which she has been designed to carry, including seven powerful winches and also large derricks fitted at the hatches. Steam steering gear, by Messrs. Bow, MacLachlan, and Co., Paisley, is fitted amidships; the saloon and officers' accommodation is on the fore end of bridge deck, and a chart-room and wheel-house have been built above this, with

a bridge which will give every facility to the officers in the navigation of the vessel. A set of triple-expansion engines will be supplied and fitted by the builders, having cylinders 25in., 41in. and 67in. diameter by 4ft. stroke. As she left the ways the vessel was named Onslow, by Mrs. T. W. McIntyre.

On Saturday, June 18th, there was launched from the yard of the Tyne Iron Shipbuilding Company, Limited, of Willington Quay-on-Tyne, a steel screw steamer built to the order of Stag Line, Limited, of North Shields—Messrs. Joseph Robinson and Sons, managers—and of the following dimensions, viz., Length, 345ft.; breadth, 46ft.; depth, 27ft. 2in. moulded; and to class 100 A1 at Lloyd's on the spar-deck rule. This vessel has water ballast fitted right fore and aft on the cellular system, and is also fitted with all modern improvements for the rapid loading and discharging of cargo, including five double-cylindered steam winches, direct-acting steam windlass, large donkey boiler, steam steering gear by Messrs. Clark, Chapman, and Co., Limited, and Hastie's screw gear aft. The engines, which are to be supplied by Messrs. North Eastern Marine Engineering Co., Limited, are of the triple-expansion type, having cylinders 23in., 38½in., and 64in. by 42in. stroke, and working at a pressure of 180 lb. On leaving the ways the vessel was named the Clematis, by Miss Gladys Robinson, daughter of Mr. Walter Robinson. This is the eighteenth vessel that the Tyne Iron Shipbuilding Co., Limited, has built for the same owners.

There were launched on Monday, 20th ult., from the yard of Messrs Cumming and Ellis, shipbuilders, Inverkeithing, other two trawlers for the new fleet building by them for Messrs. Muirheads, Trawlers, Limited, Granton. The dimensions of the vessels are 109ft. by 21ft. by 11ft. 9in. They are being fitted by Messrs. Hutson and Sons, engineers, Kelvinhaugh, Glasgow, with compound engines having cylinders 21in. and 42in. by 24in. stroke. Steam is supplied from large boilers working at 100 lb. pressure. The vessels are fitted with all modern improvements used in connection with fishing with the new Otter gear, a double set of which has been supplied by the builders. Double-barrelled steam winches are also fitted on board each vessel. Accommodation for officers and crew is fitted aft and forward; special rooms are fitted for captain and engineer. The vessels are built throughout of steel 20 per cent. in excess of Lloyd's requirements, and as they are intended for fleeting, the builders have kept in view the excessive strain they are subject to while at work, and have strengthened the parts most liable to be affected. The shell plating for half the vessel's length amidship is double at the load line, and heavy cope irons are fitted outside the doubling plates. On leaving the ways the vessels were named Mount Rosa and Mount Viso.

On June 14th, the s.s. Laura, built by Irvine's Shipbuilding and Dry-docks Company, Limited, West Hartlepool, to the order of Messrs. The Pyman Steamship Company, Limited, of the same town, proceeded to sea on her trial trip. Her dimensions are as follows:—320ft. by 46ft. by 23ft. ½in., with poop, extra long bridge, and topgallant forecastle, cellular double bottom for water ballast, all fore and aft and in after peak. Special regard has been paid for dealing with rapid loading and discharging of cargoes, for which large hatchways have been fitted, with the company's latest type of powerful winches, and double derricks to each hatch, together with all the latest improvements in the entire outfit of the vessel, including Lord Kelvin's compasses, &c. The boats are placed on a platform deck overhead, and forming an awning for the protection of the crew in tropical climates. The engines, which have been built by Messrs. Thos. Richardson and Sons, Limited, Hartlepool, are of the triple-expansion type, with cylinders 24in., 38in., and 64in., stroke 42in.; steam being supplied by two single-ended boilers working at a pressure of 160 lb. per square inch. During the trial a mean speed of 11½ knots was obtained, and the owners expressed themselves highly satisfied with the smooth working of the engines and general equipment of the vessel.

On the 20th ult., Messrs. Ropner and Son, Stockton-on-Tees, launched a steel screw steamer of the following dimensions:—Length between perpendiculars, 325ft.; breadth extreme, 48ft.; depth moulded, 24ft. 3in. The steamer has been built to the order of Messrs. Watts, Watts, and Co., of London, and is of the three-decked rule, with one deck laid, full poop, long bridge, and topgallant forecastle. The saloon and cabins for captain and officers will be fitted up in the poop; the accommodation for engineers is arranged under the bridge amidships, and the crew will be berthed in the forecastle as usual. She has a double bottom on the cellular principle for water ballast, and will carry about 5050 tons deadweight on Lloyd's freeboard, on a light draught of water. She will have a direct steam windlass, steam steering gear amidships, placed at the after end of the engine skylight, with powerful screw gear aft, five large steam winches, a horizontal multitubular donkey boiler, stockless anchors, &c. This is the eighth steamer built by Messrs. Ropner and Son for the same owners. She will be fitted with a set of triple-expansion engines by Messrs. Blair and Co., Limited, having cylinders 23½in., 39in., and 64in. by 42in. stroke, and two steel boilers 15ft. 3in. by 10ft. 3in., with 160 lb. working pressure. As the steamer left the ways Miss Mabel, daughter of Colonel Ropner, gave her the name of Romford.

On Tuesday, June 21st, there was launched from the shipbuilding yard of Messrs. Robert Stephenson and Co., Limited, a novel specimen of naval architecture in the shape of a large steel derrick pontoon, built to the order of Messrs. W. Cory and Son, Limited, London. This pontoon, which is 500ft. long, 47ft. 6in. extreme width, and 12ft. 6in. in moulded depth, is to be placed on the Thames for the discharging and loading of coal, and when finished will form one of the novel sights on that river. The pontoon, which is ship-shaped at the ends, with a poop at either end, has four lines of rails running nearly the entire length of the structure. On the outside or stream side, on which the steam colliers are to lie, there are to be nine hydraulic grabs, with weighing machines attached, running on one pair of rails. With these grabs the coal is to be taken out of the colliers—which can lie two at a time alongside—be weighed, and the weight registered, and then swung round and discharged into nine shoots, which travel on the other pair of rails. These shoots shoot the coal into barges floating on the opposite side of the pontoon. These barges then deliver the coal all round London wherever there is a waterway. The pontoon is entensively subdivided into compartments, and has a double bottom throughout about two-thirds of its length. The hydraulic power is supplied by three large pumping engines, and a large accumulator is placed at each end. In addition to the nine hydraulic grabs there are six powerful hydraulic warping capstans and rollers for warping the barges into position. This hydraulic work is to be supplied by Messrs. Tannett, Walker, and Co., of Leeds. Steam is supplied to the pumping engines, pumps, &c., by four large marine-type boilers; powerful duplex ballast and bilge pumps are fitted for pumping from every compartment. Large charcoal filters are fitted, for filtering the river water used in connection with the hydraulic plant, and the waste water from the cranes is filtered and returned to the main supply tank. There is a complete set of workshops on board, so that all repairs can be attended to by the staff on board, such as carpenters' shop, smith's shop, platers' shop, fitting shop, iron stores, wood stores, rope stores, and general stores, each occupying a large compartment. A large kitchen with range and grill, and separate dining-rooms are provided for the coalies, meters, engineers, lightermen, &c., and a handsome room is fitted up for the directors' meetings. There are also private cabins for the engineers and captain in charge. The pontoon will be moored in the Thames by four large 2½in. mooring chains at each end, attached to specially-constructed screw piles in the bed of the river, and special heavy cable stoppers, each weighing about seven tons, are provided for fixing the chain on board. The whole derrick is lighted throughout with the electric light, and the current for the lights on the grabs and shoots is taken off a traveller attached to the rails on which they travel. Portable cables are also provided for lighting the holds of vessels discharging alongside. The pontoon has been built to the designs of Mr. H. Shoosmith, the company's engineer, and has been superintended during construction by him and his assistant, Mr. S. P. Coaker. The builders found it would be dangerous to launch such a long, shallow structure in the usual way, viz., in the direction of its length, and it was therefore laid down broadside on to the river and launched. The first plate of the bottom of this pontoon was placed on the blocks on the 2nd February, 1898, and the building of this large structure has therefore taken about four and a-half months, which we think is a very creditable performance. The launching, which was performed by the dropping of large weights on the different daggers simultaneously by the cutting of a ribbon, was performed by Miss Campbell, daughter of the manager of the shipyard of Messrs. R. Stephenson and Co., Limited, who named the pontoon Atlas No. 3, in the presence of a large number of friends and spectators. The pontoon has been so designed that cranes of special construction are capable of lifting seven tons each without producing an undue inclination of the vessel, and these will operate the grabs holding two tons of coal, and with suitable ships as much as 800 tons per hour will be weighed and transhipped from steamers to river lighters. The pontoon will work continuously night and day, the relays of workmen being taken on board by steamers owned by the company. The complete installation will give employment to about 500 workmen.

## AMERICAN ENGINEERING NEWS.

*(From our own Correspondent.)*

*Heavy train load.*—A train of 55 loaded coal cars was recently hauled on the Chicago and Eastern Illinois Railroad, the train being about 2000ft. long, and weighing 2900 gross tons. The train was made up as a test of the new Consolidation goods engines, and consisted of 55 coal cars, each carrying 40 net tons of coal, the engine and tender, and the caboose. The run of 120 miles was made at the rate of 20 miles an hour, with two stops. For the first 25 miles the line has ascending gradients, rising 70ft. in the first five miles, and 107ft. in the 25 miles. In the next 49 miles the line descends 97ft., and then rises 82ft. in seven miles. For 34 miles from Chicago there is a steady down gradient, the line falling 162ft. in this distance. The heaviest gradients are 1 in 250 and 1 in 317, the latter being three miles in length. The weight of the train was distributed as follows:—

| | |
|---|---|
| Locomotive and tender | 268,000 lb. |
| Coal cars (weight empty) | 1,815,000 ,, |
| Coal, 40 tons per car | 4,400,000 ,, |
| Caboose | 27,000 ,, |
| Total | 6,510,000 ,, |

The engine which hauled this enormous train was of the Consolidation type, having eight coupled driving wheels, and a two-wheeled leading truck or bogie. Its principal dimensions are as follows:—

| | |
|---|---|
| Cylinders | 21in. by 26in. |
| Driving wheels | 4ft. 6in. |
| Driving wheel base | 15ft. 6in. |
| Total wheel base | 24ft. 4in. |
| Length over engine and tender | 64ft. |
| Weight on driving wheels | 143,000 lb. |
| Weight of engine and tender | 120 tons. |

*Charges for electric current.*—In the arrangements made by the Cataract Power and Conduit Company for selling the current generated by the Niagara Falls power plant, it is provided that all payments for power are to be made monthly. The amount of each monthly payment will consist of a charge for service and, in addition, a charge for power. The former is 4s. 2d. per kilowatt per month, and will depend only upon the amount of power which the user may require the company to keep available and ready for his use. The charge for power will depend upon the aggregate amount used as determined by integrating meters installed by the company on the consumer's premises. The charge for power will be determined from the following schedule, the units being kilowatt hours:—

| Units per month. | Charge per unit for current up to | Charge per unit for excess. |
|---|---|---|
| | d. | d. |
| Up to 1,000 | 1,000 units—1 | — |
| 1,000 ,, 2,000 | 1,000 ,, —1 | 0·75 |
| 2,000 ,, 3,000 | 2,000 ,, —¾ | 0·60 |
| 3,000 ,, 5,000 | 3,000 ,, —0·6 | 0·50 |
| 5,000 ,, 10,000 | 5,000 ,, —0·5 | 0·40 |
| 10,000 ,, 20,000 | 10,000 ,, —0·4 | 0·37½ |
| 20,000 ,, 40,000 | 20,000 ,, —0·37½ | 0·35 |
| 40,000 ,, 80,000 | 40,000 ,, —0·35 | 0·33 |
| Over 80,000 | 80,000 ,, —0·33 | 0·32 |

As power other than electric power is usually measured in horse-power the above figures have been converted into their equivalent horse-power units, as follows:

| Charge per kilowatt hour. | Charge for I.H.P. for 300 days of 10 hours. | Charge for I.H.P. for 365 days of 24 hours. |
|---|---|---|
| d. | £ s. d. | £ s. d. |
| 0·32 | 2 17 7 | 8 7 9 |
| 0·33 | 2 19 5 | 8 13 0 |
| 0·35 | 3 2 9 | 9 3 1 |
| 0·37½ | 3 7 5 | 9 16 8 |
| 0·40 | 3 12 1 | 10 9 6 |
| 0·50 | 4 9 11 | 13 1 5 |
| 0·60 | 5 7 8 | 15 14 8 |
| 0·75 | 6 14 10 | 19 12 7 |
| 1·00 | 8 19 2 | 26 7 1 |

*Piston valves in locomotives.*—There is at the present time a growing tendency to experiment with piston valves for locomotives, which is partly a result of the long and successful service of such valves in the hundreds of Vauclain four-cylinder compound locomotives now in use. It is also in part a result of a general impression that a piston valve is practically in perfect balance, but investigation appears to show that this is no inherent advantage, but that, on the other hand, some piston valves are decidedly inferior to some D-valves in this respect. It is evidently a case of proper study and design, as in other details of engine practice. For instance, the steam at the valve chest pressure which is admitted to the interior of the piston valve to set out the packing rings, exerts a constant pressure, while the pressure on the outside varies with the proportion of the ring which covers the port. The ordinary D-valve can be balanced nearly to the point at which the pressure under the valve will raise the valve from its seat, and allow steam to pass between the seat and the valve to or from the cylinder. The piston valves of the 106-ton engines of the Great Northern Railway have been illustrated in THE ENGINEER, and somewhat similar valves are in use on some new freight and passenger engines of the Wisconsin Central Railroad, with cylinders 20in. by 26in. for the former, and 19in. by 26in. for the latter. The valves are 20in. long, 6¾in. inside diameter in the body, and 12in. diameter at the ends—over the packing rings—for a length of 3in. The valve travel is 7in. Live steam enters through the body of the valve and the exhaust steam passes out at the ends. Investigation of a balanced D-valve and two forms of piston valves, showed that with the valves on the centre and no steam in the cylinders the pressures forcing the valves upon their seats were 16,106 lb., 32,504 lb., and 6460 lb. At full port opening, the pressures were 16,106 lb., 19,690 lb., 7382 lb., 29,678 lb., and 3895 lb., respectively.

*Heavy express locomotives.* — The Grand Trunk Railway has recently put on some big express engines of the ten-wheel type, having six coupled driving wheels, and a four-wheeled leading truck or bogie. They have very long boilers, set high above the frames, and the engines are painted black from the nose of the pilot or cowcatcher to the rear of the tender, relieved only by the name of the road and number of the engine done in aluminium leaf. The main drivers have cast steel centres and the others have "steeled cast iron" centres, with tires secured by shrinkage and retaining rings, the middle pair of drivers having blind tires. The bogie and tender wheels also have steel tires. All the rods are grooved, and the coupling rods have solid ends. The boiler i of the extended wagon top type, with a wide shallow fire-box dropped low in front, the crown sheet being supported by radial stays. A compressed air sand jet is used, and the engine and tender are fitted with the Westinghouse brake. The leading dimensions are as follows:—

| | |
|---|---|
| Cylinders | 20in. by 26in. |
| Driving wheels | 6ft. |
| Truck wheels | 3ft. 1in. |
| Weight on drivers | 124,990 lb. |
| Weight, total | 165,000 lb. |
| Wheel base, driving | 15ft. 8in. |
| ,, truck | 6ft. 6in. |
| ,, total | 26ft. 11in. |
| Boiler, diameter | 5ft. |
| Rail to centre of boiler | 8ft. 9½in. |
| Boiler pressure | 200 lb. |
| Fire-box, length | 10ft. 7in. |
| ,, width | 3ft. 4½in. |
| ,, depth in front | 6ft. 4½in. |
| ,, depth at back | 5ft. 5in. |
| Tubes, (iron), number | 291 |
| ,, diameter outside | 2in. |
| ,, pitch | 2¾in. |
| ,, length over tube plates | 15ft. |
| Grate area | 33·44 sq. ft. |
| Heating surface, tubes | 2269·03 sq. ft. |
| ,, ,, fire-box | 185·85 sq. ft. |
| ,, ,, total (with fire-brick-arch tubes) | 2470·63 sq. ft. |
| Smokestack, diameter | 16in. |
| ,, height | 37in. |
| Rail to top of smokestack | 14ft. 7¼in. |
| Tender— | |
| Wheels | 3ft. 7in. |
| Wheel base | 10ft. 6¼in. |
| Coal capacity | 20,000 lb. |
| Water capacity | 4500 gallons. |

## THE IRON, COAL, AND GENERAL TRADES OF BIRMINGHAM, WOLVERHAMPTON, AND OTHER DISTRICTS.

*(From our own Correspondent.)*

THE ensuing quarterly meetings of the iron trade are fixed for July 13th and 14th at Wolverhampton and Birmingham respectively. What course ironmasters may then take to recoup themselves the extra cost of coal, which has arisen from the Compensation Act, is not yet determined, but it seems likely that an attempt will be made to abolish discounts in the iron trade as well as the coal trade, as the outcome of the coalmasters' action. Fair orders are to hand for best rivet and horseshoe iron from Australia, which are enabling some makers of the qualities to run their works fuller than usual. There are also good advices from agents at the Cape, Russia, and Japan, for sheet bars, hoops, &c. Bars, hoops, and strips sell briskly, and these departments of the finished iron trade are distinctly better off than any others. The quarter is closing up well with these producers, and they have sufficient orders on their books to keep them fully occupied. Common bars command on an average £5 15s., medium qualities £6 5s., and marked bars £7 to £7 10s. Tube strip and some other light sections of iron are 2s. 6d. per ton dearer than a month ago, and £5 17s. 6d. to £6 is now quoted by some makers. Hoops are £6 5s. to £6 10s., and rivet iron £7 to £8, according to quality.

For galvanised iron the shipping houses are steadier customers, and there is more demand on home account. £9 15s. to £10 f.o.b. Liverpool remains the quotation in this connection. Quotations were this—Thursday—afternoon in Birmingham firm for nearly all classes of rolled iron. Best bar makers reported themselves fairly well engaged at £7 to £7 10s., but production suffers from the increasing use of steel or boiler plates and girders. The sheet iron trade is similarly affected by the growing preference for steel sheets, which are now to be bought at practically the same price as iron sheets. Doubles—in the black state—were quoted to-day £6 7s. 6d. to £6 10s., and trebles £7.

There is a continued good demand for pig iron, the prices for which have been strengthening all through the quarter. Foundry pig iron is particularly buoyant, owing to the activity at the district foundries, and the strength in forge iron also arises from the limited production and small stocks, as well in the Derbyshire and Northamptonshire districts as in South Staffordshire. There is a general opinion that the time has come for more furnaces to be put under blast in all the pig iron districts.

Prices of pigs are quoted:—Staffordshire cinder pigs, 42s. to 43s.; part-mine, 45s. to 48s.; all-mine, 52s. to 55s.; and best ditto, 66s. 6d. to 69s. 6d. Northampton forged pigs are 45s. to 46s. 6d.; North Staffordshire, 45s. to 47s. 6d.; and Derbyshire, 47s. to 48s. 6d. Surprise is expressed at the continued heavy output of pig iron in Germany. The output last month was 610,553 tons, against 583,418 tons in April, and 579,613 tons in May last year. The output for the first five months of the year aggregates 3,003,496 tons, showing an increase on the first five months of 1897 of 203,984 tons, or more than 7¼ per cent.

The decline in prices in the American pig iron market was discussed with much interest this afternoon, and it is thought that we have not yet seen the bottom. Bessemer pig in the States is now quoted 12 dols. to 12 dols. 50 c.; No. 1 foundry, 11 dols. 25 c. to 11 dols. 75 c.; No. 2 foundry, 10 dols. 50 c. to 10 dols. 75 c.; and grey forge, 10 dols. to 10 dols. 25 c. The cause of the fall in America is understood to be the excessive production, but makers of Bessemer pig have agreed to produce the make 10,000 tons per week.

Steel is buoyant, and prices stiff on the basis of £4 15s. to £5 for Bessemer billets, £5 to £5 5s. for Siemens ditto, and £6 5s. for bars. Plates £5 17s. 6d. to £6 2s. 6d., angles £5 10s. to £5 15s., and girders £6 5s. to £6 7s. 6d.

It is announced that Mr. Robert Heath, of the Ravensdale Ironworks, North Staffordshire, is dismantling his concern, and in place of the existing twenty-eight old-fashioned puddling furnaces is erecting thirty-six modern furnaces.

The miners employed by the Lilleshall Company, and at Priorslee and Donnington, Salop, have asked for an advance of 10 per cent in wages. The demand not being complied with, the men handed in their notices, to expire in fourteen days. If a strike takes place it will affect over 2000 hands.

In the Birmingham workshops engineers and machinists are well employed, and for electrical appliances there is a brisk call. In the railway carriage and wagon-building shops a large aggregate of work is booked. The light ironfounders are well situated for orders, and extra buying is registered for gas stoves.

The Black Country rivet makers have decided to ask their employers to concede an advance of 6d. per cwt. in wages.

The Wolverhampton Chamber of Commerce has determined to inquire from the Agent-General for Canada whether, under the new tariff which shortly comes into full force, goods will receive the benefit of 25 per cent. reduction on the ordinary tariff rates, and, if so whether the 25 per cent. is an advantage as against Germany also, or whether Germany has any favoured treatment in the matter, and, if so, to what extent.

## NOTES FROM LANCASHIRE.

*(From our own Correspondents.)*

*Manchester.*—The position in the iron market here is perhaps just at present a little anomalous. There is a continued lull of buying so far as pig iron is concerned, but in manufactured material, especially for structural purposes, large inquiries are coming forward, and throughout all branches of the steel trade exceptional activity prevails. The engineering industries in all departments also continue in the exceedingly brisk condition to which I have previously made reference, whilst as regards new work it is not so much a

question of securing orders to replace those running out, as of being able to comply with requirements for delivery. This general activity is necessitating numerous extensions of works in various parts of the district, and the position throughout the trade, both as regards engineering firms and the workmen, has perhaps not been so satisfactory for a very considerable time past.

A very steady tone still prevails in the Manchester iron market and the continued absence of buying pig iron occasions little or no concern, as this is usually the quiet period of the year, and the general comment is that trade is maintaining so exceptionally strong a position. Amongst users of pig iron there is just at present a disposition to hold back from purchasing until after the turn of the quarter, except to cover any pressing requests, and as in most cases they are well bought, the weight of business giving out for the moment is necessarily small. There is, however, comparatively little or no underselling in the open market, and makers, so far from attempting to push sales, are for the most part indifferent about quoting, deliveries on account of contracts already on their books being sufficient to take away present production, and to keep them going for some time ahead. Both local and district makers are firm at their quoted rates of 47s. 6d. for forge to 49s. 6d. for foundry Lancashire, less 2½; 43s. 6d. for forge to 46s. for foundry Lincolnshire, and 50s. to 51s. for foundry Derbyshire, net cash delivered Manchester. Outside brands offering here are practically without quotable change, but are not in all cases maintaining the full prices recently ruling. Open brands of Middlesbrough foundry can be bought at 48s. 4d. to 48s. 7d., with makers selling at about 49s. 4d. net, delivered by rail Manchester. Scotch iron is obtainable at about 49s. 6d. to 49s. 9d. for Glengarnock, and 50s. to 50s. 3d. for Eglinton, net, delivered Manchester docks, with American pig iron quoted from 47s. and 47s. 6d. for ordinary qualities, up to 50s. and 50s. 6d. for special brands, but not much business doing.

The position in the finished iron trade, so far as bars are concerned, continues strong, makers having plenty of orders on their books, with prices firm at the minimum basis of £5 15s. to £5 17s. 6d. for Lancashire, and £6 to £6 2s. 6d. for North Staffordshire qualities, delivered here. Sheets remain quiet, with prices low, not averaging above £6 17s. 6d. to £7 2s. 6d., and hoops are in but limited demand at the association list rates of £6 10s. for random to £6 15s. for special cut lengths, delivered Manchester district, and 2s. 6d. less for shipment. Nut and bolt makers report business as moderate, with prices unaltered.

In the steel trade the exceedingly strong tone noticeable recently is well maintained, and not only for shipbuilding and boilermaking requirements, but for general structural work there is a large inquiry, which is steadily forcing up prices of most descriptions of manufactured material. In hematites No. 3 foundry qualities average about 59s. 6d. to 61s. 6d., less 2½, with local billets £4 10s. net. Local steel bars are still obtainable at about £6 2s. 6d., although the general quotations are £6 7s. 6d. to £6 10s. for the better qualities. Steel bridge plates could not be bought under £6 7s. 6d. to £6 10s., with boiler plates ranging from £6 15s. to £7 delivered here, and some makers indifferent about quoting at all.

The other week I mentioned that Messrs. Hulse and Co., of Salford, had been formed into a private limited company, and I may add that the new company has started under the most favourable conditions. The shops have never before been so full of work, which includes a large number of important orders for various special types of machines. Amongst the tools on order, is a massive 40in. double duplex patent twin-screw shafting lathe, with bed about 97ft. long, and fitted with two fast and two movable headstocks, and three sliding carriages, each with duplex rests. The lathe weighs about 150 tons, and will remove 30 cwt. of cuttings per hour. In addition the company has six other of their large patent twin-screw lathes of various sizes in progress. Other heavy work includes a number of massive planing and drilling machines for armour plate requirements, some special shaping machines for operating on stern frames, and a large number of vertical lathes of various sizes, whilst, as usual, the company has on hand a number of vertical and horizontal milling machines, both of the planer and ordinary types. A special machine, now being completed, is a large locomotive frame plate drilling and slotting machine, with four cross slides, each carrying a drilling and a slotting head, the bed of which is about 44ft. long, and the total weight of the machine about 50 tons. A number of special machines are also in hand for ordnance work, including boring machines for rough and finish boring tubes and hoops, special gun-turning lathes for guns up to 10in. calibre; and the company is making several complete plants for machining the elements of Belleville boilers and economisers, whilst in addition they have in hand a large number of their patent horizontal side-planing machines—to plane from 12in. up to 40in. in width.

In the coal trade, notwithstanding the slackening off in requirements for house-fire purposes, which of course is usual at this time of the year, pits throughout this district are generally being kept on full time, and although stocks of the better qualities are beginning to accumulate, these are not so far going down in quantities more than sufficient to provide the extra supplies for the winter's demand. So far as prices are concerned, these remain exceptionally firm, and there has been practically none of the giving way that usually takes place during the summer months, whilst with regard to renewals of contracts with merchants for delivery over the ensuing twelve months, these are only being entertained at advances of about 6d., and in some cases 9d. per ton over last year's prices, which, however, it may be added, were in most cases extremely low. Common round coals are in brisk inland demand for iron-making, steam, and general manufacturing purposes, and the better qualities are readily fetching 6s. 9d. to 7s. at the pit mouth, any-anything under these figures being only taken in exceptional cases. Engine classes of fuel are also moving off readily, with a tendency rather to scarceness in some of the better descriptions. Common sorts remain somewhat plentiful, if anything, and are still obtainable at 3s. to 3s. 6d.; good medium qualities are, however, scarcely to be bought under 4s. to 4s. 3d., with 4s. 6d. to 5s. quoted for the best slack at the pit mouth. On forward contracts both for steam and forge coal and engine fuel there is a continued hardening up in price, to the extent of quite 6d. per ton on common round coals and 3d. to 5d. on engine fuel.

In connection with gas coal contracts, to which I made reference last week, these are gradually being placed at advances over last year, but these represent to a large extent a levelling up of prices to one basis, rather than any definite general advance; the average prices at the pit mouth on business that has so far been done may be given at about 6s. 9d. to 7s. for the common sorts, and 7s. 9d. to 8s. for good screened gas coal.

Shipping business has scarcely been so active, buyers holding back in anticipation of some approaching settlement of the South Wales strike, and prices, if anything, are a trifle easier, good ordinary steam coal not averaging more than 8s. 6d. to 9s. delivered ports on the Mersey.

With regard to the wages question, which is to be definitely dealt with at a conference to be held in London on Wednesday next, between committees representing the Coalowners' and the Miners' Federations, from what I can gather in conversation with some of the leading colliery representatives in this district, there would seem to be very little doubt that an advance will be conceded, but it is probable it may be put forward in the shape of a proposal for a 5 per cent. advance towards the close of the year, with a further 5 per cent. deferred to a later period. Some colliery proprietors, however, would prefer to give the full 10 per cent. advance at once, and regulate prices in accordance.

*Barrow.*—There is still much firmness shown in the hematite pig iron trade, and the inquiry for terms of delivery of Bessemer qualities is fully maintained. The market is, indeed, very strong, and makers find they have a continued and regular run of orders, on the basis of which they maintain prices very firmly, this week's quotation for mixed Bessemer numbers being 51s. to 52s. 6d. net, f.o.b. In warrant iron a steady trade has been done lately, and prices are firmer than they have been at 50s. 3½d. net cash sellers, 50s. 3d. buyers. The demand for warrant iron is brisk, and during the week 23,796 tons have been cleared out of stock, making a reduction since the beginning of the year of 25,097 tons, and leaving stocks still in hand at 159,353 tons. Warrants are, generally speaking, firmly held, as prospects in the iron trade are considered good. Forty furnaces are in blast, as compared with thirty-seven in the corresponding week of last year.

Iron ore is in very brisk request, and the tonage raised from local pits is still far below the requirements of users. Prices are steady at 12s. 6d. to 14s. per ton net at mines for good average sorts net f.o.b. A good business is also being done in the better classes of ore, which are quoted at 16s. to 17s. per ton. Spanish ores are in smaller delivery generally, and prices are maintained firmly.

In the steel trade business is brisk in every department, and orders are very largely held. Makers find they have plenty of work in hand for all their mills for a considerable time to come. Orders for heavy rails and for ship plates and shipbuilding material generally are being very liberally given out, and there is now no reason to doubt that in all branches of the trade great activity will prevail during the remainder of this year. The minor branches of the steel trade are very busily employed.

Shipbuilding and marine engineers are thronged with work. The chief feature of next week will be the launch here of H.M.S. Amphitrite, a first-class cruiser.

Coal is in good demand at steady prices, and coke finds a strong and active market.

Shipping returns from West Coast ports show that last week 8790 tons of pig iron were exported, and 7126 tons of steel, as compared with 4205 tons of pig iron and 8453 tons of steel in the corresponding week of last year, showing an increase of 4585 tons of pig iron, and a decrease of 327 tons of steel. The aggregate shipments this year total up to 244,379 tons of pig iron and 269,899 tons of steel, as compared with 217,922 tons of pig iron and 220,325 tons of steel in the corresponding period of last year, showing an increase of 26,457 tons of pig iron and 49,574 tons of steel.

## THE SHEFFIELD DISTRICT.

*(From our own Correspondent.)*

THE coal trade in South Yorkshire continues in a fairly satisfactory state. Although complaints are heard amongst the men of the overcrowding of the pits, they have had no reason to complain of their wages, and, as a matter of fact, there is very little grumbling on that score. The movement for an advance has excited only a languid interest, the men being content to leave the decision with the Yorkshire Miners' Federation of Great Britain, according to the arrangement which affects Yorkshire. The Workmen's Compensation Act, which comes into force to-day, has been, on the whole, generally arranged for. Contrary to expectation, there have been very few mutual contracts under the Act, and the men as a body will participate in any advantage the exact terms of the statute provide for them. It is somewhat singular, in spite of the closure of the South Wales coalfield, that the demand for Yorkshire coal used for domestic purposes has been diminishing during the last two or three weeks; stocks are accumulating at several of the pits. The shrinkage in the demand is pretty general, London itself taking considerably less than for the corresponding period of last year. At the same time merchants are known to have very small stocks in hand, and they continue to buy simply to meet hand-to-mouth requirements.

Notwithstanding this falling off in the quantities stored at the pits, it is not at all probable that there will be any decline in values. Quotations, which are at present steadily maintained, are as follows:—Best Silkstones, 8s. 6d. to 9s. per ton; ordinary from 7s. 6d. per ton; Barnsley house, 8s. to 8s. 6d. per ton; seconds from 7s. per ton. In steam coal there is a gratifying demand in every direction, particularly for the export trade, which is shown by the heavy tonnage fowarded to the Humber ports. The weights sent from Hull and Goole to the Baltic ports are about the same as in 1897, but there is an excess of business done with places which have usually relied upon Welsh coal. For the iron trade at home a large quantity is at present being consumed, and the railway companies are taking full deliveries. Railway contracts for hard coal for the ensuing half-year are in course of arrangement. The Midland, Great Central, and North Eastern companies have been in the market. It is stated that several of the Midland Company's contracts have been let at 7s. 10d. per ton for the best qualities of Barnsley hards, while 7s. 3d. per ton has been accepted for the hard Parkgate coal. The Lancashire and Yorkshire Company have been offering 7s. 3d. per ton for Barnsley hards, but up to the time of writing have not been able to make contracts at that price. Barnsley hards are at present quoted at 8s. to 8s. 6d. per ton; seconds from 7s. per ton. In gas coal contract prices are a little firmer, although trade is not quite so brisk. For all descriptions of engine fuel full rates are being obtained, and the weights sent to the heavy textile districts and the manufacturing centres of Lancashire show that business in the woollen, linen, and iron trades must be good. Nuts fetch from 6s. to 7s. per ton; screened slack from 4s. 6d. per ton; pit slack from 2s. 6d. per ton.

In coke, in which there is an improved business, ordinary qualities fetch from 9s. to 10s. per ton, and best from 11s. to 12s. per ton.

In nearly all departments of the heavy industries activity prevails, more particularly in military, marine, and railway material. Business in several directions is being increasingly affected by the war between the United States and Spain. Orders for steel are reported to be less abundant, Swedish steel, in the finer brands, being most in demand. Swedish iron is not obtainable in quantities adequate to the requirements of manufacturers, the output being readily competed for by American and continental buyers. Common Swedish irons are easily procurable, owing to the shrinkage in the Clyde trade. The demand for Swedish steel for tubes, rims, and other accessories is very languid, compared with what it used to be at this time of the year.

The annual meeting of the shareholders of Messrs. John Brown and Co., Limited, Atlas Steel and Ironworks, Sheffield, was, as usual, a very harmonious gathering. The dividend was a little less than last year—6¾ per cent., as compared with 7½ per cent.—this being attributable to the engineers' strike, which practically restricted the year's operations to five months out of seven. The chairman, Mr. J. D. Ellis, made an interesting statement with regard to the need for increasing their output of armour plates. It was no secret, he said, that the First Lord of the Admiralty, Mr. Goschen, and Sir William White, called upon manufacturers of armour plates in Sheffield in May. Captain Tresidder and himself had a long and important conversation with those gentlemen, and although he could not make public what passed at the interview, the representations made to them by their visitors convinced them that not only in the immediate, but in the more distant future, there was such a probability of larger orders that they did not hesitate to recommend their colleagues to proceed to lay out a considerable amount of money to increase their capabilities for turning out armour plates. He regretted to say that a large number of these extensions would not be done this year, simply because it was impossible for them to obtain the necessary machinery, but about this time next year he hoped they should be working a considerable quantity of the extra machinery. In the meantime, their shops were producing a very large quantity, and their books would show there would not be any deficiency in orders during the next twelve months for the full weight they should be able to produce. He regarded with disfavour the Workmen's Compensation Act, and disputed Mr. Chamberlain's statement that the measure would greatly save litigation between masters and men in case of accidents. He had been at the Atlas Works for forty-four years, during which time their men had numbered from 4000 to 8000. From time to time they had had accidents, but during the whole of that period they had never spent sixpence in litigation for an accident. They had dealt with the men, as they believed, justly and generously, and had invariably given satisfaction, but had never spent sixpence in law. In regard to the company's collieries, which were now producing over 25,000 tons of coal per week, the company had joined an insurance association consisting entirely of colliery owners in that and the West Yorkshire district, so that, in case of fatal accidents occasioned by an outbreak, the loss would not fall on the company alone, but be distributed over the whole body of the association. Minor accidents would be dealt with as before. Mr. C. B. McLaren, M.P., seconded the adoption of the report, which was agreed to unanimously. Mr. J. D. Ellis and Mr. McLaren were re-elected as directors of the company.

A special meeting of the Council of the Sheffield Chamber of Commerce was held on Tuesday to consider a scheme for a mutual insurance association. It was reported that adhesions to the scheme had come in from firms and manufacturers paying a total of £815,000 per annum in wages. This was £185,000 per annum below the minimum which had been fixed by the general meeting held the week before. The Council had before them an offer from an insurance company to take the whole of the risks of the mutual association for one year, so as to give time for the association to be formed, the insurance company to hand over to the promoters of the mutual association certain discounts, to form a nucleus for a reserve fund for that association and to pay the expenses of inaugurating it. The offer of the insurance company was accepted.

## NORTH OF ENGLAND.

*(From our own Correspondent.)*

ON the whole a more favourable report may this week be given respecting the pig iron trade of this district than has been possible for some time past; for, though this is almost invariably a quiet period of the year, being between the spring and autumn shipping seasons, an improved business has been done during the last few days, and there has been a "firming up" of prices, more especially for the foundry qualities, which are what are generally required for shipment. The tone of the market has become more cheerful, and the demand is stronger; in fact, offers to buy have this week been more numerous than for a considerable time. The shipments, too, have increased, whereas they usually fall off about this time, seeing that the waterways on the Continent are low, and the barges that are employed to carry the iron from the ports on the other side to the works in the interior can only be loaded to half their ordinary capacity. This increases the cost of delivery, and less is accordingly sent than in the spring or autumn. It is satisfactory to find the stocks declining, and to learn that producers are so well supplied with orders. Some of the leading makers have sold the bulk of the iron they will produce during the next quarter, and most of them have not much to sell for delivery over July and the early part of August; and what is more satisfactory to them is that the majority of their contracts were booked when they could get 41s. per ton for No. 3 Cleveland pig iron. Only a very small proportion has been sold under 40s. 6d. The situation is more favourable, in that there is no pressure to sell either among the makers or the merchants, and the competition of second hands has not been less keen for some time. It seems to be now the general opinion that the lowest in prices has been experienced, at least until after the autumn shipping season closes. The fact that the strong efforts of the "bears" have been unable to bring No. 3 down below 40s., and that prices of pig iron generally have so long been about stationary, would indicate the good position of the sellers.

Last week there was some business in No. 3 Cleveland G.M.B. pig iron, for prompt f.o.b. delivery, at 40s.; this week the lowest figure entertained has been 40s. 1½d., though there have been plenty of offers to buy at 40s., and at the time of writing 40s. 3d. is the minimum both of makers and merchants, there being a decided upward tendency. Warrants are also improving in price, and the number of forced sales made by weak speculators has been less during the last week than is usual towards the end of a month, though being the termination of the half-year also, it might have been expected that there would be more. This element in weakening prices has during June been markedly of small account. For delivery over July and August 40s. 6d. has been accepted. No. 1 Cleveland pig iron is shady at 42s. 3d.; No. 4 foundry at 39s. 6d.; grey forge at 38s. 3d.; and mottled and white at 38s.

The demand for hematite pig iron is good, and deliveries to local consumers are very heavy. The price of mixed numbers is 51s. per ton, but leading producers quote 51s. 6d. Buyers freely offer 50s. 6d. to 50s. 9d., but cannot meet with sellers willing to accept the figures. Imports of Rubio ore into this district are at present very large, though the stocks held by consumers are unprecedentedly heavy, yet the prices are not reduced, though the rates of freight are. It seems likely now that the supply of ore will be interfered with, as the Americans threaten to send a portion of their navy over to the Spanish coast; besides this, men will be withdrawn from the mines to join the army. Yet there are merchants who will sell for delivery a considerable distance ahead, and this notwithstanding that a tax is threatened.

Exports of iron and steel from the Cleveland district have been only moderate for June. Up to the 29th ult. the quantity of pig iron shipped was 99,195 tons, as compared with 99,816 tons in May, and 106,319 tons in June, 1897. The stock of Cleveland iron in Connal's public warrant stores on 29th ult. was 89,980 tons, a decrease for the month of 2676 tons, while the stock of hematite was 44,999 tons, a decrease for June of 390 tons.

Manufactured iron and steel are in good request, and as producers are well supplied with contracts the tendency of prices is upwards. The continued stoppage of the collieries in South Wales has greatly reduced the production of the iron and steel works in that district, and manufacturers in other centres are reaping the benefit. The prosperity of the shipbuilding industry is very marked, and likely to continue so—a circumstance which causes much activity at the plate and angle mills. Steel ship plates are not under £5 17s. 6d., and steel ship angles £5 15s. at works, less 2½ per cent., and some producers are asking half a crown more for plates. The wages of steel millmen at Consett, and at other plate manufactories which regulate their wages by the Consett sliding scale, will during the next quarter remain the same as in the last three months, the rise in the realised prices of plates not having been enough to justify an advance. Iron ship plates are sold at £5 12s. 6d.; iron ship angles at £5 8s. 9d.; and common iron bars at £5 7s. 6d., all less 2½ per cent. f.o.t. The steel rail trade is very strong, and inquiries are becoming more numerous, especially on Indian account.

Shipbuilding orders are satisfactory, quite as numerous as the builders are prepared to tackle, and there can be no doubt that the second half of the year will be as busy as the first half has been. The Wear yards so far this year have launched 37 vessels of 115,627 tons, this being 18 per cent. more than in the first six months of last year. It is believed that a new shipbuilding yard will be established at Blyth. Sir W. G. Armstrong, Whitworth, and Co. have booked an order for three oil-tank steamers of 5000 tons each for a French firm, and Sir James Laing, of Sunderland, will build three similar vessels for English owners.

The activity in the engineering industry has led to the wages question cropping up again, the men deciding that they should have a larger share in the prosperity. The members of the Amalgamated Society of Engineers claimed 2s. per week advance on time, and 5 per cent. on piecework, and at a conference on Tuesday at Newcastle the employers offered them 1s. per week on time, and 2½ per cent. on piecework—half of what they asked—from the first full pay in August. This proposal is to be laid before the men for their consideration, but as it is stated that the employers on the Clyde have conceded the full demands, it is hardly likely that the men in this district will be satisfied with

less. The steam engine makers and the moulders, who had each asked for a 2s. advance, were offered half, and the plumbers, who asked for 2s. 6d., were also offered 1s. In these cases also the general body of the men are to be consulted.

The blast furnacemen connected with the National Amalgamated Union of Labourers at the Elswick Works of Sir W. G. Armstrong, Whitworth, and Co., Newcastle-on-Tyne, on Tuesday come out on strike, because the employers will not concede the eight-hours day, though the concession has been in operation at all the other furnaces in the North of England for some time. They have kept on at the twelve-hours day, the firm being unconnected with the Ironmasters' Association, and free to take their own course. They said that sooner than agree to the proposal they would damp the furnace down. They expect to get other men to undertake the work.

The contract for the construction of the New Mills and Heaton Mersey Line, the new loop line of the Midland Railway, is to be executed by Messrs. Walter Scott, and Co., of Newcastle-on-Tyne, the tender being for £500,000.

The death is announced of Mr. Llewellyn Roberts, one of the best known of the iron and steel works managers in the North of England. He was 73 years of age. He commenced his career at the Forest Works of Messrs. W. Crawshay and Co. in South Wales, and from there he removed to the Taff Vale Works, near Cardiff. About 1863, when the Stockton Malleable Ironworks were being erected, Mr. Roberts took charge of the rolling mills department, and in 1873 took a similar position at the Moor Iron and Steel Works, at Stockton, and subsequently he became mill manager at the Jarrow Works of Palmer's Shipbuilding and Iron Company. Some fifteen years ago he returned to the Moor Works as works manager, and assisted in altering the works from an iron to a steel manufactory. He has patented several inventions, which have been adopted at that establishment and elsewhere.

The death has also been recorded of Mr. Henry Thomas Morton, who was for many years agent for the Earl of Durham's collieries and estates. He was born in 1825, and was educated for the mining profession. He was at one time chairman of the Coal Trade Association, and has been on the board of directors of the North-Eastern Railway for the last seventeen years, being specially connected with the Finance Committee of the Ways and Works Committee of that company. He was also closely allied with several manufacturing concerns on the Tyne and Wear, and at one time owned a number of steamships. He was also a director of the Consett Iron Company.

Mr. John Philipson, head of the firm of Messrs. Atkinson and Philipson, the well-known coach-builders, at Newcastle-on-Tyne, died on Friday last, aged sixty-five years. He served his apprenticeship with his father as a carriage-builder, and after gaining experience in London he succeeded his father. The late Mr. Philipson was accepted as an authority on all matters connected with carriage-building, and he was the inventor of many improvements in their construction, as well as the author of some standard text-books, such as "Coach-body Making," "Harness," and "The Art and Craft of Coach-building." He was one of the pioneers of technical education in the North of England, and has had technical instruction classes at his own works for the last thirty years. He was president of the Institute of British Carriage Manufacturers in 1895, and a member of the Institution of Mechanical Engineers.

The coal trade is somewhat quieter, though it is much brisker than is usual at this period of the year, as the strike in South Wales is causing a heavier demand for North Country coal. Best steam coal is being sold at 12s. 6d. per ton, f.o.b., and small at 5s. 3d. The collieries are being worked to their fullest capacity now that the holidays are over, and coalowners are so well sold ahead. Durham gas coals are at 9s. 6d. to 10s. per ton, f.o.b. Blast furnace coke can be got at 14s. per ton, delivered at the Middlesbrough furnaces, but 14s. 3d. is the average price asked.

## NOTES FROM SCOTLAND.

*(From our own Correspondent.)*

THE Glasgow pig iron market has been quiet throughout the week, but the tone has been steady to firm. Scarcely any speculative business is being done in warrants, and for several weeks the demand on the part of consumers has been remarkably poor; but there has been a little more inquiry in the last few days for hematite pig iron for future delivery.

A comparatively small business has been done in Scotch warrants at 45s. 8d. and 45s. 9d. cash, and 45s. 11d. to 46s. one month. Cleveland iron has been quiet, with business at 39s. 10d. to 39s. 11½d. cash, and 40s. and 40s. 1d. one month. In Cumberland hematite transactions have occurred at 50s. 0½d. and 50s. 1½d. cash, and 50s. 3d. to 50s. 6d. one month. Buyers of hematite were prepared to give an improving figure for future delivery, in order, it is thought, to ensure supplies immediately on the close of the annual trade holidays.

The market for Scotch hematite has been steady, and merchants quote 54s. per ton for delivery in railway trucks at the steel works.

There are forty-three furnaces producing hematite pigs, thirty-two ordinary, and six basic iron, the total of eighty-one thus blowing in Scotland comparing with seventy-nine at this time last year.

The prices of Scotch makers' iron are steady. Govan and Monkland, f.o.b. at Glasgow, Nos. 1, are quoted 46s. 7½d.; Nos. 3, 43s. 1½d.; Wishaw and Carnbroe, Nos. 1, 46s. 9d.; Nos. 3, 46s. 3d.; Clyde, No. 1, 51s.; No. 3, 47s. 6d.; Gartsherrie and Calder, Nos. 1, 51s. 6d.; No. 3, 47s. 6d.; Summerlee, No. 1, 52s.; No. 3, 47s. 6d.; Coltness, No. 1, 55s.; No. 3, 48s.; Glengarnock, at Ardrossan, No. 1, 51s. 3d.; No. 3, 46s. 3d.; Eglinton, at Ardrossan or Troon, and Dalmellington, at Ayr, Nos. 1, 47s. 9d.; Nos. 3, 46s.; Shotts, at Leith, No. 1, 52s. 6d.; No. 3, 48s. 6d.

There is a gradual decrease in stocks of pig iron in Glasgow warrant stores, but the weekly reduction has not been very great. The home consumption of Scotch-made pigs is on an extensive scale, and in the last week or two the export trade has been slightly better, although it still comes much short of what it has been in some former times.

The shipments of pig iron from Scottish ports in the past week amounted to 6514 tons, against 2859 in the corresponding week. Of the total there was shipped to South America 90 tons, India 30, Australia 55, France 80, Italy 2730, Germany 120, Holland 515, Belgium 80, Spain and Portugal 80, other countries 427; the coastwise shipments being 2307 tons, against 1284 in the corresponding week of last year.

Imports of pig iron into Scotland from the North-East Coast of England amounted to 7156 tons, being 2005 tons less than in the corresponding week of last year. The total arrivals for the year to date are 214,374 tons, being 3275 tons less than in the corresponding week of last year.

In the finished iron and steel branches, business has been proceeding in a satisfactory way. The demand for iron, bars, rods, and sheets has been steady, without much change in prices. In the steel manufacture there is great activity—all the more so that work will have to be suspended about a fortnight hence for the annual trade holidays.

The improvement noticed last week in the coal trade has been maintained.

The prices of coal for shipment are up about 6d. per ton. Main coal is quoted f.o.b. at Glasgow, 8s. 6d.; splint, 9s.; ell, 9s. 3d. to 9s. 6d., steam, 10s. to 10s. 6d. per ton. The colliers have been working with great steadiness.

The Clyde shipbuilders have agreed to advance the wages of their workmen 5 per cent. on piece rates in the shipyards and boiler shops, and 2s. per week on time wages.

## WALES AND ADJOINING COUNTIES.

*(From our own Correspondent.)*

THE coal trade last week was again brisk, though in the Cardiff district there are indications of a quieter demand for steam coal. The Cardiff shipments amounted to 90,000 tons. Swansea despatched 39,209 tons, being 8000 tons more than the corresponding week last year. Newport again had but a small total:—Foreign 4638 tons, and coastwise 7189 tons. The Swansea clearances included 18,131 tons to France, 1650 tons to Madeira, 1150 tons to Sweden, 2860 tons to Germany, 1970 tons to San Francisco, 2446 tons to United States, in bunkers, and 9197 tons to home ports. The Cardiff shipments included 4400 tons to Colombo, 3600 tons to Buenos Ayres, 2591 tons to Valparaiso, 2600 tons to Rio, 1300 tons to Bordeaux and Bilbao, and 3600 to Dakar. Numerous vessels left in ballast. On one day five were so despatched. A good portion of the Cardiff shipments, I hear, was in the execution of orders booked some time ago.

A slight weakening of steam coal prices has taken place at Cardiff. In Monmouthshire the advance of 10 per cent. to non-associated colliers is likely to stiffen, if not actually advance, house coal prices, and quotations this week in some quarters have been put up 2s. per ton.

Mid-week on 'Change, Cardiff, the closing prices were as follows: Best steam coal, 20s. to 21s. 6d.; drys, 15s. to 16s.; best Monmouthshire, 17s. to 18s.; seconds, 12s. 9d. to 13s.; best steam small, 10s. 9d. to 11s.; seconds from 8s.; No. 2 Rhondda, 12s. 9d. to 13s.

Swansea prices: Anthracite, 12s. to 13s. 6d.; seconds, 11s. 6d. to 12s.; ordinary large, 10s. to 11s. 6d.; small rubbly culm, 5s. 9d. to 6s. 3d., Swansea, f.o.b., cash thirty days, less 2½. Steam coal, bituminous, patent fuel, and coke according to private arrangement. Best house coal 15s., or an advance of 4s. 6d. since the strike.

At Cardiff patent fuel is a little more active, and coke displays increased briskness. Latest prices: Patent fuel, 16s. to 18s.; furnace coke, 18s. to 19s.; foundry, 21s. to 23s. Pitwood, 14s. 9d. per ton ex ship. Iron ore: Cardiff quotations, 13s. 9d. to 14s. for Rubio; Tafna, 13s. 3d. to 13s. 6d. Swansea prices: Rubio, 13s.; Tafna, 14s. 6d.

On 'Change, Swansea, mid-week, it was reported that the pig iron market was weak, and warrant prices practically unchanged. Warrant stocks show a decrease, to be accounted for by home consumption. Most of the Siemens works were stated to be in full activity. Closing prices as follows:—Glasgow warrants, 45s. 9d. to 45s. 9½d., cash buyers. Middlesbrough No. 3, 39s. 11d. prompt, other numbers in proportion; hematite warrants, 50s. 5½d., 50s. 6d., to 50s. 5½d., f.o.b., for mixed numbers; Cumberland, according to brand; Middlesbrough hematite, 50s. 2d. Welsh bars, sheet iron, steel rails, and steel sheets, prices nominal according to arrangement. Siemens tin bars, best, £4 10s. Tin-plates: Bessemer steel cokes, 10s. to 10s. 3d.; Siemens, 10s. 3d. to 10s. 6d.; ternes, per double box, 28 by 20 c., 19s., 19s. 6d., to 21s.; best charcoal, 11s. to 12s. Wasters, 6d. to 1s. less. Black plates, £7 to £7 10s. Block tin, £69 7s. 6d. to £69 15s. Lead, English, £13 17s. 6d. Spanish, £13 6s. 3d. Copper, Chili bars, £49 8s. 9d. to £49 15s.

The shipment of tin-plate from Swansea last week totalled 51,613 boxes, receipt from works 48,954 boxes, stocks 151,547 boxes, compared with 126,120 boxes corresponding date last year. The statement on 'Change this week is that the number of mills now at work are fully employed. No alteration has been made in makers' quotations. The question as to what the men are going to do with regard to a future agreement as to a reduction of wages has not yet been fully decided.

At Llanelly further negotiations took place on Monday at Morewood's tin-plate works between the representatives of the men and Mr. Bond. The men made a new offer, which was tendered for consideration by the company. This was to work for twelve months at 15 per cent. reduction off the list, and at the expiration of that period to accept whatever wage-rate should be current in the district. Mr. Bond replied that he could not promptly give a definite reply, but he would immediately consult his friends, and hoped to be in a position this week to do so. There are strong grounds, I hear, for the belief that the men's proposals will be accepted, and in that case a re-start will follow in a very short time.

At the other works, excepting Morfa, the men offer a concession of 7½. This has been refused. At the Morfa Works a section of the tin-house hands have been called upon for a reduction of 50 per cent.

It is stated in the district that a joint conference, in the endeavour to bring about a uniform rate, will be held shortly.

In the Swansea Valley the output of steel in the district for the week was the lowest for the past two years. Of the twenty-two furnaces, twelve only are smelting, as follows:—Wright and Butler's, four; Cwmfelin, two; Duffryn, one; Milbrook, one; Pontardawe, 4. The large new furnace at Wright and Butler's is now complete; but, owing to the high price and scarcity of coal, is not expected to be started yet. A fair week's work was done at the Milbrook Mill and at Cwmfelin. Chiefly due to the stoppage of the Forest—which, it is hoped, will be only temporary—the production of tin-plates for the week was over 5000 boxes below the corresponding week of last year. The cog-wheels of the Duffryn, which went to pieces some time ago, are being replaced rapidly, and a start is assured for next week. A mill is at a standstill at the Foxhole. Among tin-house men the chief topic is impending reductions.

The Miners' Federation and Wage Conference is announced to be held in London next week between coalowners and representatives, when the application for a 10 per cent. advance will be discussed.

## NOTES FROM GERMANY.

*(From our own Correspondent.)*

ACTIVITY in the raw and manufactured iron trade, but more especially in the shipbuilding and engineering industries, has been satisfactorily maintained all through last week, and as demand and employment are likely to increase during the next months, prospects for the iron business in Rheinland-Westphalia and in Silesia may be considered favourable. Very long terms of delivery are being asked in the merchant iron trade; all the mills are in full employment, and have their order-books well filled. Consumption increases, and the tendency in quotations is upwards. Steel plates continue somewhat neglected as concerns prices. Girders are in full request, and the prices secured are better than those of previous weeks.

The following may be regarded as the present list quotations, per ton at works: Foundry pig, No. 1, M. 67; No. 3, M. 60; white forge pig, M. 58 to 59; basic, M. 60·50; Spiegeleisen, M. 66 to 67; good merchant bars, M. 125 to 155; angles, M. 135; girders, M. 120 to 128; sheets, M. 137·50 to 160, according to quality; heavy plates for boiler-making purposes, M. 157 to 180; Bessemer rails, M. 120. Exports in iron and steel have been pretty heavy lately, and there is every prospect of a regular, if not a very brisk, trade being done on foreign account during the remainder of the year. The Roumanian Government is going to spend about sixty million francs on rails and railway rolling stock, structural iron, battleships, &c.; the orders are to be placed before the end of 1899. Russia, likewise, contemplates the enlargement of her fleet by eight battleships, sixteen cruisers, three training ships, and thirty torpedo boats; the sum granted for these ships amounts to one hundred and ninety-four million roubles.

Another order for pipes, worth about twelve million roubles, will soon be given out by a company that is being formed for the laying down of the chain of naphtha-pipes from Grosny, in the Caukasus, to Astrachan. These pipes, for which orders are to be divided on two mills only, will have to be delivered free Nowrossish on the east coast of the Black Sea. German make has always found a good market in Russia, and the above orders, will therefore help to improve the tone of the export trade, German manufacturers being sure to come in for a pretty large share of these orders.

The *Rhenish-Westphalian Gazette* has published a statement, according to which German export in machines has been strongly improving for some years past. In 1897 value of German export in instruments, machines, and vehicles was more than 172 million marks, against 160·4 and 158·9 million marks in 1896 and 1895. Also this year export figures will be very favourable, the more so because Russia, which had been purchasing less freely last year, will be a good customer.

During the first four months of present year the export in machines, &c., was:—

| | 1898. | 1897. |
|---|---|---|
| Locomotives .. .. .. .. .. | 36,696 q. | 33,167 q. |
| Machines, cast iron .. .. .. .. | 405,904 q. | 347,910 q. |
| Machines, iron .. .. .. .. .. | 87,054 q. | 64,596 q. |

German export to Russia was, from January to April of present year, 16,895 q., against 9160 q. in 1897, and 12,585 q. in 1896. It may here be mentioned that German export in pit coal has likewise been increasing considerably this year, being for the period from January to April 43 million q., against 37½ million q. for the corresponding period in the year before.

The market for raw and finished iron in Austria-Hungary remains pretty much in the same position as before; at least there is no further improvement to be reported, demand for some articles, such as merchant bars, plates, and wire, having even shown a considerable weakness quite recently. Scythes and hardware, as well as tools, are selling briskly. Employment at the machine factories is irregular, and altogether unsatisfactory.

It is rather difficult to give a correct description of the business that is done on the French iron market, because work is very unequally divided. In the Department Nord and in the Ardennes district, for instance, the mills and forges are but weakly engaged, while the majority of the ironworks in the Department Meurthe et Moselle are fully occupied. On the whole, however, a normal trade is done in raw as well as in finished iron; prices show a want of firmness generally. Steel rails have been sold at 165·25f., and Paris quotations for merchant bars are 160f., girders 175f. p.t. Some rather heavy orders for the Exhibition are expected to be given out shortly, and large orders for railway material for the Colonies are likewise pending.

The improving tendency previously noticed on the Belgian iron market has continued all through last week, but the business put through generally is still of a somewhat moderate description. Prospects for a lively summer trade may, however, be considered as pretty favourable. Pig iron is extremely firm in price, foundry pig No. 3 fetching 54f. p.t.; forge pig, 53f. p.t. Billets and blooms sell briskly at 100 to 105f. p.t. A very steady demand is coming in for manufactured iron, and prices are stiff; bars No. 2, for export, sell at 127·50f. p.t.; for home consumption, 132·50f. p.t. is quoted; plates No. 2, iron, stand on 140f. p.t. for export; 135f. p.t. for inland demand; the same in steel, 150f. p.t. for export; and 147·50f. p.t. for home consumption.

All through last month the Bulgarian iron business has been brisk, owing to the activity in the building line. From Germany, 1580 q. merchant iron, 2040 q. iron girders, 481 q. wire nails, 261 q. hardware, and 202 iron plates have been imported. Austria-Hungary sold 704 q. merchant iron, 120 q. hardware, 103 q. iron bedsteads, 114 q. steel; while Belgium exported 200 q. iron plates to Bulgaria.

## THE NEWPORT HARBOUR COMMISSIONERS' WEEKLY TRADE REPORT.

EXPORTS for week ending 25th ult. were:—Coal, foreign, 4638 tons; and coastwise, 7189 ton; 2000 patent fuel; and 2290 tons iron. Imports for week ending 28th ult. were:—Iron ore, 1450 tons; 2653 loads of deals; pitwood, 337; pig iron, 1777 tons; 2 cargoes grain.

Pig iron: Scotch warrants, 45s. 10½d.; hematite warrants, 50s. 4d., f.o.b. Cumberland; Middlesbrough, No. 3, 39s. 11d. prompt. Iron ore: Rubio, 13s. 6d. to 13s. 9d.; Tafna, 13s. to 13s. 3d. Steel: Siemens steel tin-plate bars, £4 10s., all delivered in the district, cash. Tin-plates: Bessemer steel, coke, 9s. 9d.; Siemens, coke finish, 10s. Pitwood, 15s. 6d. London Exchange Telegram: Copper, £49 11s. 3d.; Straits Tin, £69 7s. 6d.

THE ATTENTION OF MANUFACTURERS is called to the permanent exhibition of manfactures and machinery, now open in Lima, in the Machinery Hall of the Exhibition Palace, under the auspices of the Government of Peru, and under the management of the National Society of Industry. No charge is made for space, no duties on exhibits, and many privileges are accorded to exhibitors. Full particulars will be given by E. Lembcke, Consul-General, 237, Winchester House, Old Broad-street, E.C.

CAN THE LOCOMOTIVE BE MADE A CONDENSING ENGINE?—The advantage of condensing exhaust steam has hitherto been confined to fixed and marine engines, on account of the impossibility of economically taking with engines mounted on wheels the necessary quantity of water; but this difficulty would cease if air could be practically employed instead of water for the cooling. A locomotive provided with an air condenser would be in the same case as a marine engine, which always has at hand the water necessary for condensing its steam; and it is evident that, if the exhaust steam of an engine be received in a space traversed by a group of tubes through which the surrounding atmosphere were made to circulate, the steam would give up all its heat to the air issuing from the tubes. By increasing the number of tubes, and giving them a sufficient length, there is little doubt that all the exhaust steam of an engine might be cooled down to any temperature desired above that of the surrounding temperature. The object of a communication by M. Carcanagues, locomotive superintendent of the Paris, Lyons, and Mediterranean Railway, in the *Annales des Mines*, is to inquire whether such condensation can be practically applied to locomotive engines; what dimensions must be given to the group of tubes for affording a sufficient cooling surface; and what force would be required to oblige the air to pass through the tubes with sufficient speed. The dimensions of the tubes could easily be determined if the formulæ were known, representing the law according to which the air traversing a metal tube, maintained externally at a given temperature, becomes heated; but, as this law was not known to the author, he considered direct experiment should be resorted to for supplying it. He therefore caused to pass, at different speeds, air drawn from the atmosphere, and consequently of known temperature, through metal tubes of different lengths and diameters, and raised externally to various temperatures, also known, the temperature of this air being measured on its leaving the tubes. After describing the apparatus and experiments, M. Carcanagues gives the results he arrived at in a series of tables for several temperatures of condensation, varying from 100 to 65 deg. Cent., and then considers the application of his investigations to an air consenser for locomotives. He finds, however, that the necessary size and weight of the condenser, and the power required to force the air through it, would be excessive as compared with the effect to be attained. In fact, the application of an air condenser to locomotives would entail a loss of power that may be estimated at 12 or 15 per cent., while it would require the addition of a tubular apparatus weighing from thirty to thirty-five tons, and of a blower that would have to force into the condenser 7063 cubic feet per second. He therefore concludes that these difficulties amount to so many impossibilities, and it may be confidently affirmed that there is nothing to be gained in this direction as regards locomotive engines.

## A NEW SERVICE BULLET.

A NEW service bullet, just adopted by the War-office, will be used for the first time in the Khartoum expedition, says the Woolwich correspondent of the *Times*. Several million rounds are being sent out for the use of the infantry who are going out to Egypt. The reason assigned for the change in the service bullet is that the Lee-Metford, though it is more deadly at ten times the range of the old musket ball, does not disable an enemy as effectively as is considered desirable. The case is elongated, and so hard that soldiers have been known to go on fighting after half-a-dozen Lee-Metford bullets have gone through them, whilst the bullet itself has passed through two or three men consecutively, shock being sacrificed for penetration. The Dum Dum bullet, now also superseded, came into use for the purpose of stopping the rush of hordes of fanatics, as it had the advantage of spreading out and breaking up whenever it encountered resistance; but there has recently been some discussion in France as to the propriety of remonstrating with the British War-office on the ground that it is contrary to the convention made with other European Powers in 1868. The new service bullet is the same diameter (·303), the same length—an inch and one-fifth—and the same weight—215 grains—as the Lee-Metford bullet, and fits all the service rifles and machine guns in use by the British Army. The case is of nickel, the base only being filled with lead. The conical end is left empty, and when it strikes the enemy burrs, opens backward, and lodges in the body, penetration being lessened and shock increased. The new bullet is spoken of as "the man-killing bullet," in contradistinction to the man-penetrating bullet. It is propelled with cordite, and has as much energy as the old Martini-Henry bullet of 410 grains had with the best gunpowder; whilst, as it is half the weight, the soldier is able to carry double the number of rounds of ball cartridge. The new bullet is being manufactured in the Royal Laboratory, Woolwich Arsenal, by men and boys working overtime, at the rate of two million rounds of ball cartridge per week; and, if the test in the Khartoum expedition proves satisfactory, a permanent stock will be kept in hand at the powder magazines at Woolwich. A contract for ten million rounds of the new ball cartridge has been entered into with Messrs. Kynoch and Co., and one with the Small Arms Ammunition Company, for a similar number.

## SHIPBUILDING IN GERMANY.

THE attention of Englishmen has been frequently called to the endeavours that are being made in Germany to induce the shipyards to stop purchasing shipbuilding material abroad. Up to the present these shipyards covered their supply to a great extent in England because they could buy here at much cheaper prices than from German establishments. The free entry of shipbuilding material which has been adhered to in order to promote German shipbuilding no doubt largely facilitated this mode of purchase, and has certainly contributed a great deal also to promote the competition of the German shipyards with foreigners. According to Consul-General Charles Oppenheime's report on the trade and commerce of Frankfort-on-the-Main for 1897, the society of the German iron and steel industries has for some years been trying energetically to open up business between shipyards and the ironworks; and the shipyards, which to a great extent are either directly or indirectly employed by the State in the construction of subventioned mail steamers or by orders for warships, have favoured these endeavours. They are willing to meet them by paying the highest possible prices for shipbuilding material, as would also the ironworks in respect to the prices they were to ask for raw material. The results of the conferences which took place for this purpose was that in order to oust British competition it was seen that it would depend on (1) a reduction of the tariff for shipbuilding material; (2) on the Government's compelling makers to use nothing but German material for all ships destined for Government transport service; (3) on the forming of a union on the part of all rolling mills capable of furnishing shipbuilding material, which would be in a position to offer a certain guarantee for prompt execution of the orders given by the shipyards.

It is evident from this that the capacity of these works is in no proportion to that of the British competition. Nevertheless a union of German sheet iron rolling mills has already been organised, which, it is asserted, has succeeded in selling a considerable quantity of shipbuilding material at a considerable sacrifice to German shipyards, and thus ousting the English competition. Moreover, an understanding has been brought about between the more important German rolling mills for the supply of ship plates, which guarantees not only the prompt delivery of the material, but also its quality. The shipyards on their part are willing, if these guarantees are continued, to also take upon themselves for the future the difference in price against the British prices. It is hoped in the industrial circles interested that the shipbuilding material needed by the German shipbuilders will in the near future be almost exclusively produced at home. The rate of freights and other reasons stand against the fulfilment of these hopes, for hitherto not only the prices of the German material have been too high, but also the cost of transport by rail surpasses the cost of transport from England. To this must be added the smaller capacity of the German works for shipbuilding material in contradistinction to that of English works, which are organised for production *en masse*. However, the attitude of the Government on the tariff question is a favourable one, and the parties interested even hope to receive price concessions as to the costs of transport for the raw ore, inasmuch as it is within the power of the Government to reduce the tariff of the State railways of its own accord, *i.e.*, grant cheaper freights. The danger indeed exists that the English competition, which hitherto held this field exclusively, may be repulsed. Great exertions will be needed to eliminate this danger, and one may be sure that if the custom of the German shipyards be once lost it will not be an easy matter over to regain it.

## THE PATENT JOURNAL.

*Condensed from "The Illustrated Official Journal of Patents."*

### Application for Letters Patent.

*** When inventions have been "communicated" the name and address of the communicating party are printed in italics.

*17th June*, 1898

13,481. ENVELOPES, C. A. W. Russell, Kinson, near Bournemouth.
13,482. FORWARD HANDLE BAR for CYCLES, E. A. Beard, Northampton.
13,483. FILLING BOTTLES, H. C. Adcock and S. F. Lyle, Worthing.
13,484. PACKING STEAM FLUID-PRESSURE JOINTS, J. Allan, T. A. Reed, and C. B. Crow, Northumberland.
13,485. SPINNING FRAMES, L. J. and T. Tetlow, Manchester.
13,486. DRIVING GEAR, J. B. Russell, T. Wardrop, jun., and J. S. Yule, Manchester.
13,487. GAS COOKING STOVES, the "Cannon" Hollow-Ware Company, Limited, and T. Ward, Deepfields, near Bilston, Staffordshire.
13,488. STOVES, the "Cannon" Hollow-Ware Company, Limited, and T. Ward, Deepfields, near Bilston, Staffordshire.
13,489. CYCLES, T. Watson, Glasgow.
13,490. HAT PINS, E. Kuhn, Birmingham.
13,491. SEWING ON BUTTONS, R. Crook and J. Clegg, Manchester.
13,492. MACHINE for TREATING PAPER, S. Milne, Dundee.
13,493. WHISKING MACHINE, R. S. Storey, Bradford.
13,494. SHUTTLES, J. Waddington, Bradford.
13,495. VATS for IMPREGNATING FABRICS, D. Horsburgh, Manchester.
13,496. STORING CORBONIC ANHYDRIDE, A. F. Watson, Dublin.
13,497. TELEPHONE MAGNETO BOXES, A. Gregg, Belfast.
13,498. COMPOUND STEAM ENGINES, W. M. Musgrave, London.
13,499. TIRES, W. W. Fyfe, London.
13,500. FABRICS for HORSE CLOTHING, G. Richardson, Manchester.
13,501. WATER-TUBE STEAM GENERATORS, J. Sampson, London.
13,502. PIPE TONGS, M. Watson, Sheffield.
13,503. DYEING SOAP, J. B. Koenig, London.
13,504. DURABLE INCANDESCENT BODIES, A. Koch, London.
13,505. COLOUR PRINTING, P. J. Livsey.—(*E. E. Lesigne, France.*)
13,506. SLIDE RULES, C. H. Bees, Birmingham.
13,507. SEPARATORS, E. Hards and D. J. Springer, London.
13,508. PERMUTATION PADLOCK, C. C. A. Bauercamper, London.
13,509. DEVICES for ADVERTISING, J. P. K. Clark, London.
13,510. HOLDING BICYCLES in POSITION, J. H. Giger, London.
13,511. HEATING FURNACES, T. and W. Smith, London.
13,512. CYCLE BELL and BRACE, E. Kipling, London
13,513. TRAPS, E. Talbot, London.
13,514. REGULATORS for BOILER FEED, J. Nutting, London.
13,515. OBTAINING WATER, G. Petersen and C. E. Möller, London.
13,516. DRIVING CHAINS for VELOCIPEDES, H. Andrews, London.
13,517. ICE CREAM-FREEZING APPARATUS, W. H. Pearse, London.
13,518. DRAIN PIPE-CLEANING APPARATUS, R. G. Restall, London.
13,519. MEAT-BREAD, O. Lischner, London.
13,520. CYCLES, H. L. Davis, London.
13,521. FERROUS COMPOUNDS, C. F. Wüffing, Old Charlton, Kent.
13,522. CYCLE MUDGUARD, H. Smith, Buckhurst Hill, Essex.
13,523. COUPLINGS for RAILWAY VEHICLES, F. Graff, London.
13,524. SUSPENDING WINDOW SASHES, H. Beyer, London.
13,525. DOOR PLATE, W. von Borucki, London.
13,526. DOOR CHECKS, H. T. le Page, London,
13,527. TERMINAL for ELECTRIC CONNECTIONS, P. C. Middleton, London.
13,528. COMBINED BRUSH and COMB, A. Morelle, London.
13,529. ADJUSTABLE STAND, P. Druxes and A. Grünter, London.
13,530. RECORDER, G. M. Riley, London.
13,531. FRUIT and FLOWER IMPROVER, O. Thomas, Windsor.
13,532. FIRE LIGHTERS, J. H. and A. H. Gilbert, London.
13,533. DISPLAYING GOODS, F. M. Johnson, London
13,534. GAME of SKILL, H. E. Skinner and J. Nichol, London.
13,535. CLUTCH MECHANISM, G. F. Redfern.—(*Brouhot and Co., France.*)
13,536. WELLS, A. Fauck, London.
13,537. AUTOMATIC FLUSHING CISTERN, R. G. Howson, London.
13,538. SUPPLYING AIR to OIL LAMPS, H. Salsbury, London.
13,539. TIRES, E. E. Brand, London.
13,540. MEDICINE BOTTLES, S. F. Shamoun, London.
13,541. DISPLAYING CARDS, J. Schiele and S. Hackelberg, London.
13,542. MOTOR-CARS, J. H. Boll and P. W. Potter, London.
13,543. ROLLER BLINDS, E. Edwards.—(*R. Richter, Germany.*)
13,544. HARBOUR and COAST DEFENCE, A. van Bibber, London.
13,545. PULLEY BLOCKS, J. Harris and H. Newham, London.
13,546. PNEUMATIC TIRES, C. K. Welch, London.
13,547. BICYCLE SUPPORT, J. and H. N. Brown, London.
13,548. APPLYING RED LEAD to JOINTS, W. Johnson, London.
13,549. ATTACHING ARTICLES to CYCLES, F. Harris, London.
13,550. DEVICES for SECURING PURSES, B. Haddon, London.
13,551. DISCHARGING SHIPS' CARGOES, G. Scott, London.
13,552. FEEDING YOUNG BIRDS, E. B. Steele, Liverpool.
13,553. CIGARETTE CASES, L. Hall, London.
13,554. INSERTION SOLES for BOOTS, W. A. H. Hampel and A. Schneider, London.
13,555. MOTOR CYCLES, A. F. Spooner.—(*F. Bouilly, France.*)
13,556. STAMP BATTERIES, F. Freeman and E. S. Brett, London.
13,557. TELEPHONE CABLES, L. T. B. Saunderson, London.
13,558. TELEGRAPH NUMBER BOARD, E. F. H. Keane, London.
13,559. ATMOSPHERIC BURNERS, A. M. Plaisetty, London.
13,560. COATING METALLIC SURFACES, H. W. Dover and P. Phipps, London.
13,561. COLOURING MATTERS, A. G. Green, A. Meyenberg, and The Clayton Aniline Company, Limited, London.
13,562. SUSPENDING DEVICES for LAMPS, J. Y. Johnson.—(*G. J. Cox, Victoria.*)
13,563. MOWING MACHINES, J. P. and E. E. Goss, London.
13,564. PRODUCTION of ACIDS, J. Y. Johnson.—(*The Badische Anilin and Soda Fabrik, Germany.*)
13,565. PREPARATION of AERATED LIQUIDS, F. E. V. Baines, London.
13,566. SALVAGE and COLLISION MATS, J. H. C. Leuty, London.
13,567. INCREASING the PRESSURE of GAS, H. U. Wollaston, London.
13,568. PRINTERS' ROLLERS, J. Davison, London.
13,569. JOINTING ELECTRIC CABLES, J. H. Barker, London.
13,570. ATTACHMENT of BROOM HANDLES, J. Smith, London.
13,571. COVERS for BOOKS, J. Geer, London.
13,572. GUNS, J. C. Gelly, London.
13,573. PORTABLE ACETYLENE GAS LAMP, La Société Chaussard et Cie. and C. E. Vignes, London.
13,574. GUARDS for CIRCULAR SAWS, S. Lebus, London.
13,575. BILLIARD SKITTLE TABLE, E. Altenburg, London.
13,576. UMBRELLA FASTENERS, E. Behle, London.
13,577. ALBUMS, J. Minten, London.
13,578. ICE-MAKING CELLS, L. Sterne, London.

*18th June*, 1898.

13,579. PUNCTURE-PROOF TIRE COVER, R. Halvey, Galway.
13,580. MAIL-CART BODIES, E. Harden and A. Foster, Manchester.
13,581. SELF-INFLATING AIR CHAMBER for TIRES, C. Cole, Harrogate.
13,582. ADVERTISEMENT BOARD, T. F. Matheson and A. E. Chanler, Glasgow.
13,583. WATER TAPS, A. Honig, London.
13,584. MOTOR VEHICLES, J. W. Glover and T. Greves, Warwick.
13,585. INFLATORS for CYCLES, A. E. Jenks, Wolverhampton.
13,586. ELECTRIC CABLES, G. C. Allingham and W. Fennell, London.
13,587. PROPELLER for STEAMSHIPS, E. A. Ashbury and T. Whitmore, Swansea.
13,588. SECURING PNEUMATIC TIRES, S. Macdonald, London.
13,589. VELOCIPEDES, F. Westwood, Birmingham.
13,590. CYCLE STEERING, J. Stephens, Staines.
13,591. STEERING LOCKS for VELOCIPEDES, J. Meek, Coventry.
13,592. VELOCIPEDE DRESS-GUARD FITTINGS, J. Meek, Coventry.
13,593. CYCLE HOLDERS, R. W. H. Rodney, Bristol.
13,594. FAST HEADSTOCKS of LATHES, J. Miley, Bradford.
13,595. PARCEL CARRIER for CYCLES, G. N. Preen, Kidderminster.
13,596. SLEEPING BERTHS, W. J. Fieldhouse, Birmingham.
13,597. PACKING of GLASS BOTTLES, J. Smith, Glasgow.
13,598. AUTOMATIC ACETYLENE GAS GENERATOR, E. K. and W. Hutton, Galashiels.
13,599. COIN-PREPAYMENT MECHANISM, D. B. Peebles, Glasgow.
13,600. HUBS for CYCLE WHEELS, A. King, Nottingham.
13,601. BICYCLES, W. Wall, Bradford.
13,602. TRANSMITTING ROTARY MOTION, G. Atherton, Manchester.
13,603. MACHINERY for PRESSING BRICKS, W. Johnson, Leeds.
13,604. REMOVABLE BOTTLE-STOPPERING DEVICE, A. Thiems, Germany.
13,605. CYCLE STANDS, E. Ward, Birmingham.
13,606. LADIES' HAT HOLDER, A. E. Busby, Birmingham.
13,607. STOCKING SUSPENDER CLIPS, A. E. Busby, Birmingham.
13,608. SYRINGES, A. Pumphery, Birmingham.
13,609. EXPLOSIVE MIXTURE, J. Grossmann, Manchester.
13,610. HIGH-SPEED STEAM ENGINES, A. Coats, jun., Glasgow.
13,611. "ACCOMMODATION" IRON JOIST, A. Burridge, St. Brivaels, near Coleford.
13,612. LOCOMOTIVE BOILERS, H. Thuile, London.
13,613. WOVEN-WIRE CYCLE SADDLES, A. E. Wale, Birmingham.
13,614. DISTRIBUTING OIL from TANKS, W. Butler, London.
13,615. FLY-FISHING HOOKS, J. W. F. Cullen, Glasgow.
13,616. ASSISTING the STARTING of VEHICLES, A. W. Major, London.
13,617. ROTARY WATER METERS, J. J. Tylor, London.
13,618. APPARATUS for DRYING, S. S. Bromhead.—(*Möller and Pfeifer, Germany.*)
13,619. CELL CYLINDERS, S. S. Bromhead.—(*Möller and Pfeifer, Germany.*)
13,620. HATS, J. C. Meyer, London.
13,621. PROJECTILES without CASES, L. Partl, London.
13,622. VENETIAN AWNING BLINDS, J. G. Wilson, London.
13,623. BOX for AUTOMATICALLY DELIVERING PAPERS, E. L. Anderson, London.
13,624. MOTOR VEHICLES, G. F. Redfern.—(*Brouhot and Co., France.*)
13,625. SUPPORTING BICYCLES in RAILWAY VANS, E. Payart, London.
13,626. KEYBOARDS of PIANOS, A. Le Jeune, London.
13,627. VALVE for PNEUMATIC TIRES, A. Cole, Liverpool.
13,628. CHAINLESS DRIVING GEAR for BICYCLES, R. Becker, Manchester.
13,629. SHUTTLE for EMBROIDERING MACHINES, W. P. Thompson.—(*Stickerei Feldmühle vormals Loeb Schoenfeld and Co., Switzerland.*)
13,630. AUTOMATICALLY RE-FILLING SHUTTLES, W. P. Thompson.—(*Stickerei Feldmühle vormals Loeb Schoenfeld and Co., Switzerland.*)
13,631. CYCLES, J. W. Parker, London.
13,632. SAFETY LOCK, H. Stammel, London.
13,633. TYPEWRITERS, H. C. and F. R. D. Scroggs and C. F. A. Saxby, London.
13,634. HEADING MACHINES, A. Farnhill and J. A. Throp, London.
13,635. CONSTRUCTION of FLOORS, J. T. Szek, London.
13,636. ACETYLENE GENERATORS, C. S. Forbes, London.
13,637. CHOPPING WOOD, J. Robbins and H. C. Burton, London.
13,638. MUSIC DESKS and LEAF TURNERS, M. Simpson, London.
13,639. APPARATUS for TRANSMITTING SIGNALS, A. B. y Baqué, London.
13,640. ADVERTISING ELECTRIC SIGNS, J. L. Johnston and Bovril, Limited, London.
13,641. DRIVING MECHANISM for CYCLES, H. Vert, London.
13,642. ATTACHING CURTAINS to CURTAIN-RODS, F. H. and G. E. Galloway, London.
13,643. LAY of SHEETS on PRINTING MACHINES, F. W. Vickery, London.
13,644. OBTAINING STEREOSCOPIC EFFECTS, C. Raleigh, London.
13,645. PRODUCTION of CARBIDE of CALCIUM, W. R. Smith, London.
13,646. SPRING JOINT for SELF-CLOSING UMBRELLAS, O. Levilly, London.
13,647. GUARDS for WATER GAUGES, J. Hopkinson and J. Hopkinson and Co., Limited, London.
13,648. COVERS for BOOKS, L. H. Bliss, London.

*20th June*, 1898.

13,649. CLEANING WINDOWS, E. J. Masters and G. H. Couves, Gravesend.
13,650. SHUTTLE BOX MECHANISM, E. Hollingworth.—(*H. Wyman, United States.*)
13,651. BURNERS, H. J. Yates and J. D. Prior, Birmingham.
13,652. SELF-STEERING CYCLE, J. Parsons, Camelford, Cornwall.
13,653. DRYING GRAIN, J. Rose, Hull.
13,654. SIFTER, G. J. Gibbs, Bradford.
13,655. LOOMS, The Technical Manufacturing Company, Limited, and P. Oakes, Burnley.
13,656. CHAIR, W. J. Richards and T. Davies, Aberkenfig, R.S.O., Glamorgan.
13,657. CAMERAS, H. D. Herring, Salford.
13,658. BROOMS, T. W. Taylor and T. Robson, Newcastle-on-Tyne.
13,659. TOY, R. Haswell, Liverpool.
13,660. PROJECTILES, J. Verity and E. D. Dunlop, Liverpool.
13,661. CHAIN MUD GUARD for BICYCLES, J. S. Phillips, London.
13,662. PRODUCTION of DARK-BLUE DYES, E. Rolffs, Berlin.
13,663. SEWER-VENTILATING SYSTEM, C. H. Jeffs, Manchester.
13,664. SURVEYORS' ADJUSTER, G. Gardiner, Clacton-on-Sea.
13,665. LABEL HOLDER, H. Dorizy, London.
13,666. FUSES, W. Clark, Sunderland.
13,667. MACHINE GUARD, J. A. Hewetson and W. Lambert, London.
13,668. FIRE-IRONS, J. H. Helliwell, Birmingham.
13,669. EASELS for DRAWING, N. de Tornau, Leipsig, Germany.
13,670. TROUSER-SUPPORTING DEVICE, J. Stewart, London.
13,671. TOY, J. Kellett, London.
13,672. RECORDING the POSITION of MEN, W. S. Carey, London.
13,673. AMBULANCE VEHICLES for HOSPITALS, C. Powell, London.
13,674. FIRE-LIGHTER, M. Theirig, London.
13,675. LEG BATHS for HORSES, W. F. Godden, London.
13,676. KEEPING GLOVES in SHAPE, W. J. Godden, London.
13,677. APPLIANCES for BORING the EARTH, J. Cox, London.
13,678. The BROMIDE TEST FRAME, E. E. Cornaby, London.
13,679. OPENING CANS, R. Kendrick and W. Harding, London.
13,680. ELECTRIC BATTERIES, S. W. Hart and E. J. Clark, London.
13,681. PUMPS, J. P. Hall, London.
13,682. INCANDESCENT LAMPS, V. Saglier and E. D. Marçay, London.
13,683. APPARATUS for CLEANING KNIVES, J. Puddy, London.
13,684. DRIVING GEAR for VEHICLES, E. N. Stoney and A. Sharp, London.
13,685. ALARM, W. J. Brooks, London.
13,686. ORDNANCE-SIGHTING APPARATUS, A. A. Common, London.
13,687. FURNACES, F. C. Day and The Acetylene Illuminating Company, Limited, London.
13,688. CAMPHOR, J. E. T. Woods, London.
13,689. PRODUCING ASBESTOSISED PULP, T. H. Cobley, Dunstable, Bedfordshire.
13,690. SOLUBLE PRODUCTS, F. Silberstein and L. Lilienfeld, London.
13,691. VALVES for STEAM ENGINES, W. H. Bushel, London.
13,692. ECCENTRICS, W. H. Bushel and L. R. S. Tomalin, London.
13,693. VESSELS, F. W. Golby.—(*J. M. Fehrenbach, United States.*)
13,694. PROTECTOR for CYCLE WHEELS, F. G. Potter, London.
13,695. ENGINES, T. Tomlinson, London.
13,696. INTERNAL COMBUSTION ENGINES, T. Tomlinson, London.
13,697. SEWAGE FILTER BEDS, R. O. Wynne-Roberts, London.
13,698. GLASS-MIXING APPARATUS, G. de R. de Sales, London.
13,699. BENDING MACHINES, E. and R. Cornely, London.
13,700. FLYING MACHINES, G. L. O. Davidson, London.
13,701. FRICTION CLUTCHES, A. P. Morrow and H. H. Fulton, London.
13,702. DYNAMO ELECTRIC MACHINES, H. J. Joel, jun., Ilford, Essex.
13,703. ENGINES, C. M. Linley and C. T. B. Sangster, Birmingham.
13,704. CARBURETTERS for ENGINES, C. T. B. Sangster, Birmingham.
13,705. SPEED GEAR, C. M. Linley and C. T. B. Sangster, Birmingham.
13,706. GLASS-WARE, J. M. Humphreys, London.
13,707. ELECTRO-ACOUSTIC TELEGRAPH, N. Flechtenmacher, London.
13,708. WEIGHING QUANTITIES of SUBSTANCES, T. Douglas, Liverpool.
13,709. ELECTRIC TRAIN PROPULSION, O. H. E. Kaselowsky, London.
13,710. PREPARATION against SWINE FEVER, G. Lorenz, Liverpool.
13,711. DESTROYING SOOT in CHIMNEYS, T. Volle, London.
13,712. ECONOMISING COAL, T. Volle, London.
13,713. WHEEL-RIMS, D. Young.—(*T. B. Jeffery, United States.*)
13,714. PREPARATION from "SALIGENIN," L. Sell, London.
13,715. METAL PIPING, T. Brooks and A. M. Ayles, London.
13,716. CANNING GOODS, A. Opawski and E. Murmann, London.
13,717. LUBRICATOR for PLUMMER BLOCKS, S. H. A. Jones, London.
13,718. ALBUMINOUS PREPARATIONS, C. D. Abel.—(*The Actien-Gesellschaft für Anilin Fabrikation, Germany.*)
13,719. UTILISING EXHAUST STEAM, E. B. Caird and T. J. Rayner, London.
13,720. COIN-FREED METER MECHANISM, T. H. Minshall, London.
13,721. SUSPENDED ELECTROLIERS, J. G. S. Cunnington, London.
13,722. MACHINE for FINISHING BOOT-WELTS, H. Raab, London.
13,723. STEERING VEHICLES, R. Vetter, London.
13,724. ACETYLLENCO-ETHYLENE BLUE, O. Imray.—(*The Farbwerke vormals Meister, Lucius, and Brüning, Germany.*)
13,725. PRODUCING DESIGNS upon PAPER, W. F. Toifel, London.
13,726. INSTRUMENT for CLEANING TEETH, F. Harrison, London.
13,727. HERMETICALLY CLOSING BOTTLES, O. Imray.—(*W. Nägeli, Germany.*)
13,728. EMPTYING CESSPOOLS, R. Fiedler, London.
13,729. ADJUNCTS of LOOMS, B. Lange and C. Kathol, London.
13,730. SECURING CARRIAGE SEATS, A. J. Boult.—(*C. Remy, France.*)
13,731. FEEDING STRIPS in BOX-MAKING MACHINES, A. J. Boult.—(*M. R. Partzsch, Germany.*)
13,732. COIN-CONTROLLED MECHANISM, W. L. Wise.—(*G. H. Cheney, United States.*)
13,733. PASSENGER VESSELS, E. H. O. R. Ropner, London.
13,734. BOTTLE STOPPERS, L. Schreyer, London.
13,735. TENSION SPOKES for VEHICLES, C. Fickelscheer, London.
13,736. DRESSING TIN ORES, J. Coad and J. Eustice, Southampton.

*21st June*, 1898.

13,737. GAS MOTORS, P. L. Renouf, London.
13,738. CURTAIN RINGS, A. Thatcher and E. Adams-Randall, London.
13,739. DOOR-HOLDER, A. C. Lidster, Hull.
13,740. TIE RETAINER, H. Leigh, Manchester.
13,741. ROAD TRANSPORT VEHICLES for OIL, T. Davies, Liverpool.
13,742. GUARD for CIRCULAR SAWS, J. Anderson, Newcastle-on-Tyne.
13,743. GARDEN SPRINKLERS, C. Walton, Sheffield.
13,744. LOOMS for WEAVING, E. Hollingworth.—(*H. Wyman and W. Redding, United States.*)
13,745. WHEELS, W. Ives, Halifax.
13,746. BRICK KILNS, W. Beak, jun., Bristol.
13,747. PREVENTING THEFT from POCKETS, M. S. Carr, Bristol.
13,748. SKIVING MACHINES, H. A. Oldershaw, Leicester.
13,749. HOODS for COVERING EYES of HORSES, R. B. Wright, Glasgow.
13,750. AUTO-MOTOR CYCLES, J. G. A. Rhodin, Manchester.

13,751. WINDING FRAMES, F. A. Holt, Manchester.
13,752. ILLUMINATED FOUNTAINS, T. R. Wollaston, Bowdon, Cheshire.
13,753. FASTENING SHAFTS, W. L. and F. J. Bullows, and E. Manion, Walsall.
13,754. FASTENING of WINDOWS, J. Windsor-Richards, Manchester.
13,755. CLIPS, H. and F. Rudd, Birmingham.
13,756. COATING TUBULAR LENGTHS, C. Harvey, Birmingham.
13,757. WORK-SUPPORTING APPARATUS, A. G. Brookes. —(*J. W. Brooks, United States.*)
13,758. DISPLAYING ADVERTISEMENTS, J. Kay, Burnley.
13,759. CABLES, G. C. Allingham and W. Fennell, London.
13,760. EXPLOSION MOTOR, W. Adtorf, Cologne, Germany.
13,761. FRICTION CLUTCH, K. Leverkus, Charlottenburg, Germany.
13,762. MOVABLE COAL STAITHS, J. Fielding, Gloucester.
13,763. DOUBLING FRAMES, G. H. and W. Thomson, Manchester.
13,764. INDICATING a SHIP'S COURSE at SEA, W. Spink, Glasgow.
13,765. QUADRUPLEX TELEGRAPHY, S. G. Brown, Bournemouth.
13,766. PLATES for EXTRACTING PRESSES, R. Middleton, Leeds.
13,767. CORK TIRES, F. Menzies, A. Urquhart, and J. Menzies, Queensbury, N.B.
13,768. BOXES, F. G. Johns, London.
13,769. APPLYING ELECTRIC FORCE to BALLOONS, M. Vasseur, London.
13,770. FIRE ENGINE, F. W. Golby.—(*L. Portes and T. Cambier, France.*)
13,771. ACETYLENE TABLE LAMPS, &c., G. Josephsohn, London.
13,772. FLUSHING CISTERNS, R. W. McDonald, London.
13,773. FORKS, W. H. J. Lance, London.
13,774. CAPSULES, C. Weidinger and F. Kiesewetter, Halifax.
13,775. WASHING GRAIN, A. Harvey, London.
13,776. CUSHIONED PRINTING STAMP, L. R. Blackmore, New York.
13,777. TOBACCO PIPE and WHISTLE, J. and W. Argyle, London.
13,778. WASHING MACHINES, J. J. and L. C. Francis, London.
13,779. FILTERS, H. R. Kuersten and A. M. Knoble, London.
13,780. TRANSMITTING MOTION, V. Bélanger, London.
13,781. ELECTRIC BLOCK SYSTEM, L. C. Werner, London.
13,782. PREVENTING BOTTLE RE-FILLING, J. H. Poole, London.
13,783. BAGS, G. Schindling, London.
13,784. HANDLE BARS, J. Money and W. Clark, London.
13,785. LIFTING JACKS, H. Heilen, Bonn-on-Rhine, Germany.
13,786. EXTRACTING OIL from COCOA-NUTS, J. C. W. Stanley, London.
13,787. COOLING DEVICES, F. Oakley, London.
13,788. BOTTLE-CORKING MACHINES, E. C. Seward, London.
13,789. PRINTING CYLINDERS, E. L. Sallés, London.
13,790. INHALING MEDICINAL VAPOURS, H. H. Lake.—(*Koch and Heller, Switzerland.*)
13,791. FARE-INDICATING APPARATUS, F. W. G. Bruhn, London.
13,792. FOOTBALLS, A. J. Henderson, London.
13,793. ELECTRIC GENERATORS, E. Edwards.—(*P. A. Emanuel, United States.*)
13,794. PROPULSION of CYCLES, G. B. H. Austin, London.
13,795. COUPLING SHAFTS, T. F. Edwards and J. L. White, London.
13,796. MOTOR for CYCLES, H. H. Lake.—(*A. Fritscher and A. R. Houdry, France.*)
13,797. COLOURING MATTERS, H. R. Vidal, London.
13,798. SUPPORTING BOTTLES, R. N. Cunningham, London.
13,799. STRINGING LAWN-TENNIS RACKETS, A. E. L. Slazenger and J. H. Hitchcock, London.
13,800. MERCURY, J. C. Mewburn.—(*Chemische Fabrik von Heyden Gesellschaft mit beschränkter Haftung, Germany.*)
13,801. CUTTING FIREWOOD STICKS, C. F. Parsons, London.
13,802. JUGS, A. Wiederhold, London.
13,803. WIRING BOTTLES, R. M. and C. E. Chambers, London.
13,804. BOTTLE STOPPERS, H. A. and R. H. Griffiths, London.
13,805. PNEUMATIC ACTION for ORGANS, A. Gavioli, London.
13,806. PNEUMATIC ACTION for ORGANS, A. Gavioli, London.
13,807. SHEATH DRIVING TOOL for NAILS, A. Marks, London.
13,808. CABLES, G. G. M. Hardingham.—(*Felten and Guilleaume, Germany.*)
13,809. ELLIPTIC CHAIN DRIVING GEAR, W. F. Williams, London.
13,810. CARD-TEASELLING MACHINES, E. Gressner, London.
13,811. SLIDING DOORS for RAILWAY GOODS WAGONS, J. E. Owen, J. C. Gabel, jun., and G. F. McKinney, London.
13,812. HOLDING COTTON REELS, J. and T. Whitehead, London.
13,813. VEIL FASTENERS, H. Thorpe and H. J. Salter, London.
13,814. THREADING PAY SLIPS, &c., F. H. Blockley, London.
13,815. ADJUSTABLE SPANNER, A. H. Middleton, London.
13,816. ALTERNATING PISTON ROTARY ENGINES, J. H Parsons, London.
13,817. COUPLING CYCLES, W. P. Thompson.—(*de Heiwaen and Legraad, France.*)
13,818. COIN-OPERATED SIGNAL for TELEPHONES, W. P. Thompson.—(*H. R. Mason and E. D. Weimer, United States.*)
13,819. AUTOMATIC GOVERNOR, W. P. Thompson.—(*C. J. Schuster, United States.*)
13,820. SEWING MACHINES, W. P. Thompson.—(*E. Meyer-Nägeli, Switzerland.*)
13,821. CLOSING JARS, R. Hengstenburg, Liverpool.
13,822. DOMESTIC GRATES, T. Armstrong, Manchester.
13,823. BOTTLE-STOPPERING DEVICE, P. Wollenberg, London.
13,824. SPARK ARRESTERS, T. Thorson, Liverpool.
13,825. HANDLES, P. Taylor, Manchester.
13,826. BAKERS' OVEN, A. Rauber, Liverpool.
13,827. ELECTRIC MOTORS, R. Belfield.—(*R. H. Hassler, United States.*)
13,828. PRUNING TOOLS, D. S. Donzella, London.
13,829. TRANSMITTING MOTION, E. W. Serrell, jun., London.
13,830. ACETYLENE GAS, A. J. Boult.—(*O. Payan, France.*)
13,831. MARKING SOAP, B. Israel, London.

*22nd June*, 1898.

13,832. DRILLING MACHINES for DENTISTS, P. Volland, London.
13,833. FUSE BOX, T. Rooke and W. H. Grimsdale, London.
13,834. EMBROCATION, F. Westwood, London.
13,835. COIN-FREED APPARATUS, W. Margót, London.
13,836. CYCLE SADDLE COVER, M. Harvey, Windsor Forest, Berks.
13,837. BRACKET, J. W. Boughton, Portsmouth.
13,838. BOX, C. P. Deykin, Birmingham.
13,839. BINDINGS for GARMENTS, J. H. Cooke, E. H. Stansby, and B. Cooke and Co., Limited, Manchester.
13,840. BEARINGS, D. Drynan and A. R. Fulton, Glasgow.
13,841. EXPANSION GEAR, W. Cameron, Maryport, Cumberland.
13,842. CYCLES, C. Y. Mawson and A. L. Knapman, Cardiff.
13,843. CIGAR HOLDER, W. N. Christie, Glasgow.
13,844. BICYCLE, A. Davies, Cardiff.
13,845. SHELVES, A. Davies, Cardiff.
13,846. SPRING TIRE for CYCLE WHEELS, G. F. Guy, Ipswich.
13,847. PIVOTED WINDOW FASTENER, T. Rowland, Pontypridd.
13,848. CIGARETTE PAPER CASE, H. Synyer and C. J. Beddoes, Birmingham.
13,849. RAILWAY-SIGNALLING APPLIANCES, W. Scholes, Manchester.
13,850. IRONING BOARDS, J. B. Russell, T. Wardrop, and J. S. Yule, Manchester.
13,851. STUDS, J. E. Redhead, Liscard, Cheshire.
13,852. ORGAN "SOLO" ATTACHMENT, S. Howard, Manchester.
13,853. PLUMMET for FISHERMEN, R. McM. Hasluck, Birmingham.
13,854. RAILWAY SIGNALLING, M. Clayton and J. W. Allison, Halifax.
13,855. DRIVING CHAINS, R. Blackburn and A. G. Wigfield, London.
13,856. MEASURING LIQUID, E. A. Hellier, London.
13,857. VENTILATOR for CARRIAGES, R. T. Gillibrand, Manchester.
13,858. MOULDING MACHINE GUARD, S. Holland, Manchester.
13,859. SOUNDING APPARATUS, J. C. Dobbie, Glasgow.
13,860. REGULATING HEATING of BUILDINGS, D. Drummond, Glasgow.
13,861. ELECTRO-DEPOSITION of METALS, W. E. Heys.—(*E. Dumoulin, France.*)
13,862. ALCOHOL, W. H. Akester, London.
13,863. PHOTOGRAPHIC PRINTING, L. H. Barnard and E. D. Walrond, London.
13,864. HOT-WATER RADIATING TANK, W. D. Corteen, London.
13,865. SPRING TONGS, L. Schreyer, Glasgow.
13,866. HAT HOLDER for BOXES, R. Murray and R. Paterson, London.
13,867. BLIND ROLLER FURNITURE, B. R. Walker and H. and B. A. Woodward, Birmingham.
13,868. KETTLES, G. Bowmar, London.
13,869. PEN-NIB, F. W. Schroeder, P. W. Moran, and W. H. Henry, London.
13,870. POLISHING PASTE for BOOTS, G. Milligan, Manchester.
13,871. REDUCING FRICTION of BEARINGS, W. J. Brewer, London.
13,872. MUSICAL WIND INSTRUMENT, D. R. Broadbent, London.
13,873. RAILWAY SIGNALLING APPARATUS, W. B. Quelch, London.
13,874. TREATING ORES, G. Atwood, London.
13,875. GAS, E. J. Pennington, London.
13,876. SAFETY STOP DEVICE for ENGINES, J. K. Wright, London.
13,877. TYPEWRITERS, P. B. W. Kershaw and H. Dundas, London.
13,878. EARTHENWARE PIPES R. Ames, London.
13,879. WHEEL TYPEWRITING MACHINES, E. Edelmann, London.
13,880. EXTRACT of MALT, HOPS, &c., G. G. Cave and H. S. Stoneham London.
13,881. PURIFYING PETROLEUM, L. von J. Jarocki and T. Kiczerowski, London.
13,882. WIRELESS TELEGRAPHY APPARATUS, G. Marconi, London.
13,883. EXPLOSIVES, G. Trench, London.
13,884. DENTAL ENGINE HAND-PIECES, A. W. Browne, London.
13,885. CRANK for RAILWAY SIGNALLING, A. G. Evans, London.
13,886. DRILLING MACHINE for PAPER BAGS, G. A. W. Ehrhardt, London.
13,887. SHOE-POLISHING RAG, F. Detsinyi, London.
13,888. BOTTLE COVERS, R. Giesler, London.
13,889. TIRES, J. H. Lee, London.
13,890. TRICYCLES, T. Innes, London.
13,891. APRONS, G. H. Perdue, London.
13,892. TONGS, A. Babington, London.
13,893. OPTICAL-PROJECTION APPARATUS, J. G. Lorrain. —(*The Northern Advertising Company, Nordisk Reklame Kompagni [Aktieselskab), Denmark.*)
13,894. HAIR PINS, F. P. F. M. Rawlins, London.
13,895. REDUCING the ENERGY of MAGNETISATION of ELECTRICAL TRANSFORMERS, Siemens Bros. and Co., Limited.—(*Siemens and Halske Aktien Gesellschaft, Germany.*)
13,896. DISTILLING PETROLEUM, A. Adiassewich, London.
13,897. CORKS, W. and N. Pirrie, London.
13,898. REVOLVING ENDLESS RAILWAY, T. Crooke, London.
13,899. FRICTION-CLUTCH MECHANISM, W. R. Lake.— (*La Compagnie Française des Cycles, France.*)
13,900. BICYCLES, W. R. Lake.—(*M. F. Dal - Pozzo, Italy.*)
13,901. HORSESHOES, H. H. Lake.—(*D. and H. Paar, United States.*)
13,902. VAPORISING APPARATUS, H. A. Bertheau, London.
13,903. STUDS for HORSES, J. Jobban and J. Thury, London.
13,904. BOTTLE STOPPERS, W. R. Lake.—(*L. Drevon, France.*)
13,905. COMPRESSING GAS MIXTURE, H. A. Bertheau, London.
13,906. ROTARY ENGINE, J. L. Pisning, London.

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13,907. FIGURE PUZZLE or GAME, G. Brown, London.
13,908. THREAD WINDING APPARATUS, A. B. Morse, London.
13,909. STRAINER COVER, D. Llewellyn, Newport, Mon.
13,910. BALL BEARING FLANGES, E. H. Stanfield and F. R. Martin, London.
13,911. REGULATING GEARING CHAINS, J. A. Thompson, London.
13,912. FISHING GAG and DISGORGER, W. Smallwood, Birmingham.
13,913. CONNECTING TUBES to PLATES, O. M. Bow, Manchester.
13,914. FUEL ECONOMISER, W. G. Stones, Manchester.
13,915. PNEUMATIC TIRES, F. W. Lanchester and W H. Paull, Birmingham.
13,916. ASH CURBS, T. Wells, Birmingham.
13,917. CYCLE BRAKES, H. Brownhill, Birmingham.
13,918. MATCH CUTTER, J. Garrett and J. J. Garrett, Glasgow.
13,919. WATER WHEELS and TURBINES, A. Barr, Glasgow.
13,920. CUTLERY HANDLES, J. T. Woodhouse and A. and B. Gamble, Sheffield.
13,921. CHAINLESS BICYCLE, M. Bergeron, London.
13,922. PRINTING PLATES, J. S. Duncan, Glasgow.
13,923. GAMES, J. E. Thompson, Brighton.
13,924. POWER TRANSMISSION GEARING, J. Hutton, Scarborough.
13,925. HAT BOXES, E. V. Bertram, Lanarkshire.
13,926. FASTENING GLOVES, F. Marks, London.
13,927. DRYING of CHINA SUBSTANCES, R. Hoyle, Manchester.
13,928. BRICK PRESSES, R. Collenette, Bradford.
13,929. CUTTING ELLIPTICAL FORMS, J. Barr and R. Thomson, Glasgow.
13,930. SEPARATING MINERALS, G. Dowson, Stockton-on-Tees.
13,931. COMPOSITION for PROTECTION of METAL SURFACES, A. and J. Turner and H. F. Clough, Manchester.
13,932. STOPPERS for SCREW-MOUTH BOTTLES, T. N. Cretney, Barnsley.
13,933. ATTACHMENT for FITTINGS of SINKS, W. Mitchell, jun., Dundee.
13,934. SHAPE of VALVES, R. H. Morris and T. A. Aspden, jun., Blackburn.
13,935. ADJUSTABLE BRAKE for WHEELED VEHICLES, W. Marchant, London.
13,936. DISC BALL BRAKE for BICYCLES, E. W. Weight, Bristol.
13,937. MIXING SEEDS, R. and T. R. Sizer, London.
13,938. GLOVES, T. R. Sizer, London.
13,939. COVER for VESSELS, A. J. Boult.—(*W. Ginalski, Russia.*)
13,940. PULVERISING MACHINE, J. C. Clark, London.
13,941. MATCH-BOXES, R. P. Moncrieff, London.
13,942. STANDARD and PORTABLE ELECTRIC LIGHT, F. Thomson, Glasgow.
13,943. FILAMENTS of ELECTRIC INCANDESCENT LAMPS, W. A. Coates and R. L. Wood, Cheltenham.
13,944. BRAKES for CYCLES, A. E. Harris, London.
13,945. AIR VALVES, H. A. Wood, London.
13,946. ELECTRIC CONNECTION and COUPLING, W. H. Hunt, London.
13,947. MULTI-COLOUR PRINTING MACHINE, F. R. E. Koehler, London.
13,948. FUNNELS, E. M. Waind, London.
13,949. HORSESHOES, M. C. Gray and A. C. Goff, London.
13,950. CYCLE LAMPS, G. Gascoyne, London.
13,951. METALLIC TUBULAR CONDUCTORS, G. M Stewart, London.
13,952. SPRINGS of SWING DOORS, B. Banks and E. Verity, London.
13,953. STRETCHING FIBRES, P. S. Marshall, London.
13,954. PORTLAND CEMENT, W. L. H. Roberts, London.
13,955. VARIABLE-THROW CRANK GEAR, E. A. Yorston, London.
13,956. FLUID DISTRIBUTOR, J. Hochgesand, London.
13,957. LUBRICATOR, J. Hochgesand, London.
13,958. BOOTS, W. West, R. Poore, and L. C. Cropper, London.
13,959. VENETIAN BLIND LATHES, C. D. Large, Richmond.
13,960. ELECTRODE for ACCUMULATORS, H. Damm, London.
13,961. DRIVING CYCLES, I. Rees, London.
13,962. PREVENTING REMOVAL of STAPLE RODS, H. Schorte, London.
13,963. LOCKS, J. Tippel and F. Ramisch, London.
13,964. CLIP, T. H. Newcomb, London.
13,965. PURIFYING SANDALWOOD OIL, C. A. Steche, London.
13,966. SCREW WRENCHES, J. A. Schmidt, Germany.
13,967. POCKET KNIVES, J. A. Schmidt, Germany.
13,968. ACETYLENE LAMPS, Sir C. S. Forbes, Bart., London.
13,969. TREMBLER INTERRUPTORS, A. Wydts and O. Rochefort, London.
13,970. PLACING FOG SIGNALS, E. A. B. Bowden, London.
13,971. ROLLER BLIND FITTINGS, C. S. Todd, London.
13,972. FISH KNIVES, F. H. Davey, London.
13,973. BICYCLES, A. Bottenheim, London.
13,974. PICTURE FRAME, M. C. C. Gadeberg, London.
13,975. CYCLE SUPPORT, G. G. M. Hardingham.—(*G. W. Silleox, Belgium.*)
13,976. DREDGES, J. H. Lancaster, London.
13,977. PRESERVATION of BREAD, J. M. Kuehl, London.
13,978. BEER STRAINER, S. Austin, Manchester.
13,979. SWEAT BANDS for HATS and CAPS, J. Taylor, Manchester.
13,980. SCORERS for BILLIARDS, J. W. Moore, London.
13,981. INDIA-RUBBER BOOT HEELS, E. Edwards.—(*O. L. Förber, ——.*)
13,982. OIL ENGINES, E. Edwards.—(*W. and F. Brockhausen, Russia.*)
13,983. SPITTOONS, J. Hopkins, London.
13,984. GAS REGULATOR, E. Sondermann, London.
13,985. CASKS, C. Wittkowsky, London.
13,986. PULLING - OFF ARRANGEMENTS for LAMB'S KNITTING MACHINES, H. Donner, London.
13,987. ACETYLENE GAS LAMPS, W. V. Ebert, New York.

*24th June*, 1898.

13,988. ATTACHMENT for BEER FILTERS, J. Hambidge, Coventry.
13,989. LUBRICATORS, G. Wiltshire, Liverpool.
13,990. ACETYLENE GAS, G. Wiltshire, Liverpool.
13,991. STEELYARD BALL, Day and Millward, Limited, Birmingham.
13,992. PNEUMATIC STAMPS, T. Coombes and G. Glossop, Halifax.
13,993. SHIELD for CIRCULAR SAWS, J. Nall, Halifax.
13,994. ENAMEL PAINT, H. H. Bigland and J. Cunningham, Manchester.
13,995. BICYCLES, J. Aylward and A. E. Comley, Coventry.
13,996. TOWING SHIPS, J. C. Falconer and C. Berry, Glasgow.
13,997. KITCHEN SINKS, F. Ross, Glasgow.
13,998. BOOTS, J. C. Blackwell, Leicester.
13,999. STOP MOTIONS, W. Tunstall and J. Crabtree, Huddersfield.
14,000. PNEUMATIC TIRES for BICYCLES, J. Ridgway, Hanley.
14,001. PIPES, F. Herbert, Birtley, near Chester-le-Street.
14,002. VALVES for PNEUMATIC TIRES, H. W. Verdon, London.
14,003. PNEUMATIC LASTS for BOOTS, J. Menzies, Leith, N.B.
14,004. HOISTING APPARATUS, F. Eastmead, London.
14,005. FIRE-LIGHTER, W. F. Horn and J. S. Murphy, Liverpool.
14,006. CYCLES, J. T. Ellis, Dublin.
14,007. WORKING WIRELESS TELEGRAPHY, R. Kennedy, Leeds.
14,008. CYCLE FITTINGS, A. H. and S. J. O'Brien, and W. F. Pippet, Leicester.
14,009. MOTOR ENGINES for CYCLES, C. H. T. Alston, Glasgow.
14,010. BRACKET, J. E. Villiers, Liverpool.
14,011. MACHINES for MAKING BRICKS, W. Appleton, Liverpool.
14,012. FITTINGS for ELECTRIC LIGHT, H. C. Brown, London.
14,013. DOG COLLARS, D. Power, London.
14,014. QUAYS, W. J. Brewer, London.
14,015. VENT PEG, G. Breese, London.
14,016. CARTOON, White and Son and E. Shepherdson, London.
14,017. BOXES, C. W. Stancliffe, London.
14,018. ADJUSTING BICYCLE SPOKES, J. E. Presland, London.
14,019. HOOKS, S. Palmer, London.
14,020. LETTER-RECEIVING APPARATUS, W. R. Pether, London.
14,021. PORTABLE ELECTRIC TOOL HOLDER, A. Benham, London.
14,022. ENAMEL PROTECTOR, J. and J. H. Whitnough, London.
14,023. ATTACHING TIRES to BICYCLES, F. T. Toni, London.
14,024. DISC HUB for BICYCLE WHEELS, T. Burton, London.
14,025. TIMEPIECE, H. Ganney, London.
14,026. PENCIL SHARPENER, E. V. Barker, London.
14,027. SELF-LOCKING DOOR LOCKS, L. A. Legros, London.
14,028. VEHICLE-STEERING APPARATUS, W. E. Carmont, London.
14,029. TOWEL for USE in ATHLETIC SPORTS, A. Hiller, London.
14,030. BLEACHING COMPOUNDS, The Aluminium Company, Limited, and A. G. Haddock, London.
14,031. RESERVOIR STEAM TRAPS, F. Lamplough, London.
14,032. HOISTS, J. A. Orme, London.
14,033. STARTING RACEHORSES, B. P. and H. E. Good, London.
14,034. CHAINS for CYCLES, C. H. Guest, London.
14,035. RAISING HIGH-HANGING GAS LAMPS, H. Winkler, London.
14,036. SOUND-RECORDING APPARATUS, E. R. Johnson, London.
14,037. GAS SCRUBBERS, G. Zschocke, London, London.
14,038. FLUORO COMPOUNDS, W. Schmeisser, London.
14,039. AMALGAMATION of CRUSHED ORES, G. Fischer, London.
14,040. GAS-PRODUCING APPARATUS, J. J. Shedlock, London.
14,041. METAL CANISTERS, G. W. Baker, London.
14,042. STANCHIONS for FISHING VESSELS, A. Johnson, London.
14,043. CUTTING GRASS, &c., F. Matheson, London.
14,044. INSERTING BALLS in WHEEL BEARINGS, M. Hogrefe, London.
14,045. RECKIVERS used in HYDRO-ELECTRIC OPERATIONS, L. Lambotte, London.
14,046. ELASTIC TIRES for VEHICLE WHEELS, H. O'C. Bridgewater, London.
14,047. BRICKS, R. Bradshaw, Liverpool.
14,048. FASTENING VEILS, A. T. Scott, London.
14,049. GENERATORS for ACETYLENE GAS, K. E. Rosenthal, London.
14,050. ACETYLENE GAS, J. Billwiller and K. E. Rosenthal, London.
14,051. ELEVATOR BRAKES, G. Brown, London.
14,052. DISCHARGING PROJECTILES, J. F. Green, London.

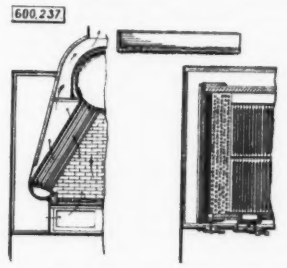
## SELECTED AMERICAN PATENTS.

*From the United States Patent-office Official Gazette.*

**600,237.** STEAM BOILER, *H. See, New York, N.Y.*—*Filed August 25th*, 1897.

*Claim.*—In combination with a furnace and a closed chamber heated by the products of combustion therefrom, a partition of reticulated or perforated material

600,237

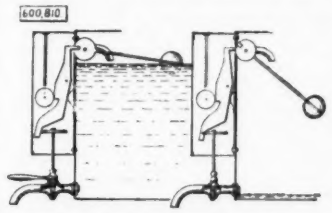


on the uptake side of and in proximity to said chamber, whereby the flame and hot gases from said furnace are retarded in the space surrounding said chamber, substantially as described.

**600,810.** COIN-FREED APPARATUS FOR ENABLING SUPPLIES OF WATER OR OTHER LIQUID TO BE OBTAINED, *R. J. Streatfeild, Bwetry, England.*—*Filed September 4th*, 1897.

*Claim.*—(1) In a coin-freed apparatus for enabling a supply of liquid to be obtained, the combination of a supply vessel having an inlet valve and a hand-operated draw-off valve, with a locking device adapted to lock the inlet valve and release the draw-off valve, or *vice versâ*, and means whereby the said locking device may be operated on the insertion of a coin, substantially as described. (2) In a coin-freed apparatus for the purpose described, the combination with a cistern or vessel for containing a supply of water or liquid, of a notched disc on the inlet valve, and a notched disc on the draw-off valve, and a lever whose opposite ends when engaged with the notch in one disc are respectively disengaged from the notch in the other disc, and a coin-receiving wheel and means for operating it to cause the coin to act upon the lever,

600,810

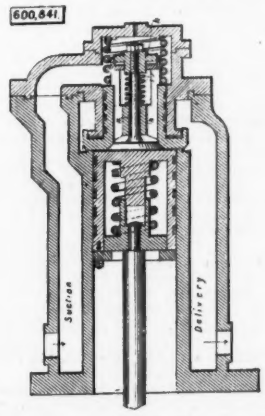


substantially as hereinbefore described. (3) In a coin-freed apparatus for enabling a supply of liquid to be obtained, the combination of a supply vessel having an inlet valve carrying a float and a draw-off valve, with a locking lever adapted to lock the inlet valve and release the draw-off valve, or *vice versâ*, and means whereby the said locking lever may be operated on the insertion of a coin, substantially as described. (4) In a coin-freed apparatus for enabling a supply of liquid to be obtained, the combination of a supply vessel having an inlet valve and a hand-operated draw-off valve, with a locking lever adapted at one end to lock the inlet valve, and at the other end to release the draw-off valve, or *vice versâ*, and means whereby the said locking lever may be operated on the insertion of a coin, substantially as described.

**600,841.** PUMP, *E. H. Oderman, Waynesborough, Pa.*—*Filed April 19th*, 1897.

*Claim.*—(1) The combination, with a piston-rod, of a yieldable piston comprising a disc rigidly secured to the piston-rod and provided with a central guide, a cup in which the said disc is slidable, said cup being provided with a central projection slidable in the said guide, a ring retaining the disc in the cup, and a spring encircling the said guide and projection, and pressing the said disc against the said ring, sub-

600,841




stantially as set forth. (2) The combination, with a pump cylinder, provided with a valve seat on its end, of a delivery valve bearing on the said seat and provided with a tubular stem having an internal guide *h*, a brake cylinder $H^1$ at its rear end, and a suction valve seat at its front end; a suction valve provided with a stem slidable in the said guide, a disc $h^1$ secured on the said stem and provided with a hub $h^2$ slidable in a hole in the bottom of the said brake cylinder, and a spring interposed between the said hub and the guide *h*, substantially as set forth.

## THE TRANS-SIBERIAN RAILWAY.

(*Continued from page 520.*)

*The Ussuri line.*—The surveys for the Ussuri line were completed in 1893, but the Commission resolved to repeat the survey for the section lying between Graskaya and Chabarovsk, in view of the remoteness of the region, and the general want of knowledge as to its nature and character. This second survey showed that the line must be built so as to take in Graskaya, and that the work of construction must not be delayed. The Minister of Communications was charged with commencing this line between Graskaya and Chabarovsk in the spring of 1894, and also with arranging for the class of work that could be carried on in that district during the approaching winter. The second survey gave a new direction to the Ussuri line, and after the station of Kedrovo, lying sixty-seven miles beyond Graskaya, the line lies ten miles distant from the river Ussuri, and hereby it was made apparent that it would be possible to build the remaining distance of the line as far as Chabarovsk equally distant from the course of the river. It was pointed out in Committee that it would be desirable to construct the first sixty-seven miles of the line as far distant as possible from the frontiers of the empire, and therefore it was resolved to build the North Ussuri line from Graskaya to Chabarovsk through the valley of the Ussuri River, and to request the Minister of Communications to confer with the Governor-General of the Amur territory as to slight deviations which might be necessary with a view to decreasing the cost of construction, and to keeping the line at a certain distance from the Chinese frontier. The cost of the North Ussuri line was fixed at £2,200,000 in 1896. The activity of the Commission with regard to the southern section of the Ussuri line, the construction of which was begun so long ago as 1891, is shown in the grants that were made for its completion by the summer of 1895. As to the North Ussuri line, the first through train from Chabarovsk to Vladivostock set out on September 15th, 1897. With a view to regulating the extremely high cost of providing for and keeping up the staff of this line, as well as for protecting the line from attacks by the Chunchusi robber bands, the Commission appointed a special "railway battalion" in 1895, for service on the South Ussuri section, and on the completion of the North Ussuri section this battalion was formed into two companies.

*The Irkutsk-Baikal branch line.*—The Commission recognised the impossibility of constructing the line round Lake Baikal in a manner to keep pace with the Trans-Siberian line running east and west of that district, and it was therefore resolved to build a temporary line from Irkutsk to Lake Baikal, and to arrange for transporting goods and passengers across the lake by means of a regular service of steamers. The original intention of laying this temporary line along the right bank of the river Angara had to be abandoned, and the line is being laid along the left bank at a cost of £250,000. At present the work extends rather more than forty miles from Irkutsk towards Lake Baikal, and several buildings and bridges are already in position.

*The steamer service across Lake Baikal.*—For this ferry service steps were taken to find suitable spots for landing places, and it was then resolved to order a steam ferry similar to those in use in Denmark and on the Canadian lakes near Detroit. It is expected that the lake will be kept open for navigation for at least ten months in the year by means of ice-breakers, and the ice-breaker to be used on the lake is now being built in a dock specially built for that purpose. The ironwork to be used in the ice-breaker is gradually being conveyed to the lake by the Siberian Railway as far as is possible, and then by the river Angara in summer and by sledges in winter. It is expected that the ferry boat will be ready for use during the winter of 1899—1900. Steps are also being taken to build landing-stages, moles, and a floating dock.

*The railway round Lake Baikal.*—Although the Commission decided to establish the ferry service described above in conjunction with the branch line from Irkutsk, it was firmly convinced that such temporary communication between the Mid-Siberian and Trans-Baikal lines should not be the cause of abandoning the idea of completing a continuous railway system across the whole extent of Siberia, and therefore orders were at once given that the necessary technical surveys should be set on foot to discover the best possible direction to be taken by the line running round the southern shore of Lake Baikal.

*The Ekaterinburg-Chelyabinsk Railway.*—In fixing the direction that should be taken by the line connecting the Siberian line with the Ural Railway, the Commission paid especial regard to the wants of the mining industry in the Ural district, for this industry is a most important branch, and has suffered from an appreciable lack of iron goods and their consequent dearness, and such goods are necessary for the proper development of this industry. Therefore the Commission fixed upon a region wherein the greatest number of manufactories was to be met with, and made Ekaterinburg the junction, as being an important town, while the branch line should join the Trans-Siberian line at Chelyabinsk. In consequence, the direction of this branch line is from Ekaterinburg across the western slopes of the Ural Mountains, near the manufactories of Severski, Polevski, Verchne-Ufaleiski, and Kyschtymski. The cost of this branch line connecting the Ural district with the Trans-Siberian Railway, including the cost of rails and the laying of them, was £655,000; this sum does not include the cost of the rolling stock. The line was finished in the autumn of 1895, and since 1896 it has been opened for regular intercourse.

*The Perm-Kotlas line.*—The question of building a line from Perm in the Ural Mountains to Kotlas on the Dwina that flows into the White Sea at Archangel was, by command of the Tsar, entrusted to the Commission of the Siberian Railway. The Commission at once recognised that the object of this projected line was principally to bring the port of Archangel into communication with the Siberian Railway by means of the Ural line and the branch line connecting Ekaterinburg with Chelyabinsk. The acquisition of a direct and independent export route by way of the White Sea is extremely desirable for Siberian produce, and is of special importance with regard to the exportation of cereals, which form the greater part of the exports. Siberian agriculture will be greatly benefited by this opening, and the farming industry of Central Russia will be also protected from the depressing influence occasioned by the importation of immense quantities of cheap corn destined for the Baltic ports. This line from Perm to Kotlas will also be of especial value in view of the local needs in Northern Russia, and above all from the fact that it will now be possible to pay more attention to developing this huge region. The conversion of Archangel into a port of trade for Western Siberia will give a great impetus to activity throughout all Northern Russia, and must at the same time help on the development of the Russian merchant service, while the establishment of sound mercantile connections between the governments of Siberia and the district of Archangel, with its energetic people of old Russian stock, cannot be without a good influence upon the extension of private undertakings in Siberia. With the intention of reducing the cost of building this line, the Commission gave orders that the work should be carried out as economically as possible; careful and repeated investigations were made as to every detail, and after duly considering the various questions on the spot, it was resolved to construct the line within the borders of the government of Viatka along the valley of the river Chepzy, and through the town of Glasov to Viatka. Some progress had already been made with the construction of this line before the final decision had been arrived at as to its ultimate course, and therefore much of this work was of no use, as it was not on the route selected. The cost of the Perm-Kotlas Railway, including the rails, laying the line, the rolling stock, and working capital, was fixed at £3,800,000.

*The technical requirements in constructing the Siberian Railway, and the supply of rails.*—In the work of construction the greatest attention was paid to making as rapidly as possible a safe and trustworthy railway embankment. On the other hand, from reasons of economy, and in order to avoid risks that might arise from want of knowledge as to the character of certain localities, it was resolved to devote more time to erecting stations for passengers and goods, so that the railway buildings might be in accordance with the local wants and with the requisite dimensions. In order to hasten the completion of this colossal railway, and at the same time to reduce the necessary outlay as much as possible, the Commission deemed that it was possible to construct the line on a simpler system than that in use on the railways in European Russia. Among other things may be mentioned the reduction of the width of the embankment from the customary 2·6 fathoms to 2·35 fathoms, the decrease in the amount of ballast under the sleepers, simplicity in decorated buildings and station buildings, and the use of a light rail weighing 18 lb. to the foot throughout the whole of the Siberian Railway. In favour of the use of a rail relatively so cheap, whereby a saving of £113,402 was effected, was the knowledge that these 18 lb. rails would be of sufficient strength for the line in the early days of its career, and that after fifteen years, which is the general life of rails of this type, it would not be difficult to replace them in case of necessity by rails of the usual heavy make, the price of which will be considerably reduced in the near future. Time has already shown the justice of this supposition; while the rails for the Siberian Railway cost on the average no less than 1 rouble 58 kopecks the pood of 36 lb., *i.e.*, 3s. 3½d. in English money, the last orders for these rails given by the Russian Government were executed at a cost of 1 rouble 18 kopecks the pood, or 2s. 5½d. In order to provide the railway with a sufficient supply of rails and other ironwork connected with railway requirements the Commission entertained the idea of establishing a steel and rail rolling-mill in Siberia, which might serve to introduce these branches of industry into the country. But as it was proved to be impossible to adapt in a short time any of the existing ironworks in Siberia to this branch of the industry, and as the certainty of the orders being duly carried out by a definite time could not be relied upon, the Commission deemed it more advisable to come to terms with the wife of the Secretary of State Plovzov, who owns the Bogoslovski Hill district in the Ural Mountains, for the supply of steel rails. At the same time it was recognised as being eminently desirable that a similar manufactory should be erected on the property of the Cabinet of the Tsar in the Altai district, which is extremely rich in iron ore, and the coal necessary to the production of iron is also present in great quantity. In the beginning of 1897 contracts were concluded between the Cabinet of the Tsar and the Eastern Siberian Iron and Machine Works Company as to leasing the coal and iron mines in the Kusnets district and in part of the Government of Tomsk, in Western Siberia; these contracts included the famous mines of Koltchugin, and referred to coal mining and the erection of ironworks for a period of sixty years. In addition to this, an order for one million poods weight of rails was given to the Nikolaievsk Ironworks on the river Angara that flows into Lake Baikal, and immediately afterwards the Commission made a contract with the new owner of the Mamontov Works for the supply of 4,750,000 poods weight of various kinds of ironwork required for building the Siberian Railway and for its future working. The geological investigations carried out in the Trans-Baikal region proved the possibility of establishing cement works in the neighbourhood of Nertchinsk, Sretensk, and Verchne-Udinsk; a private undertaking, in connection with the Amur Cement Works, offered to erect two cement works in the locality mentioned, and concluded an agreement with the Ministry of Communications to supply 300,000 tons of cement during the space of five years. As the best means of supplying the western lines of the Siberian Railway with rails and other necessary material, and also with a view to developing the coasting trade of the Russian merchant service, the Commission arranged that all necessary railway material should be conveyed to Vladivostock in the vessels of the Russian Volunteer Fleet, and in consequence of this resolve three new steamers were added to the fleet at a cost of £290,000.

*The employment of convicts and criminals on the work of construction.*—Apart from the steps taken to furnish the building material for the railway, the Commission had to take steps also for procuring workmen, and this was especially the case when the local population was engaged in agriculture. This want of workmen was met by the employment of criminals and convicts serving their terms of imprisonment in Siberia; in consideration of their services various remissions of unexpired sentences were made and the lot of the convicts generally improved, while those condemned to hard labour were allowed to work without being in chains. The local Governors-General were entrusted with full powers in the matter of conveying the criminals and convicts to the places where they were to work, and these workmen were in charge of the officials of the Land Courts and local police, whose powers and authority were not confined to one particular district, but were extended over the whole of the railway system.

*The management of the Siberian Railway.*—Among the matters that came for settlement before the Commission, mention must be made of the establishment of a special central administration in the Ministry of Communications for carrying out the complicated work of constructing the Siberian Railway. In accordance with the resolution approved of by the Tsar regarding the administration of the work of construction, all matters connected with surveys, construction, the supply of rolling stock, and all necessary material are in the hands of this central authority. This authority also is charged with coming to terms with owners of real estate as to the land required for the railway, and no limit was placed to the agreements made in its name; the heads of the various departments of construction and the officials occupied on the line are responsible to this board of management. At the same time the local Governors-General are entrusted with the supreme control of the progress of all the work of construction, with the exception of the technical and agricultural matters connected therewith.

*Divers matters.*—Apart from the before-mentioned questions other less important matters had to be decided upon by the Commission. These were rather of a special nature, and it will be sufficient to glance at them. As the result of the Tsar's expressed wish that the railway should be built as quickly as possible, the Commission sought for the Imperial authority to appropriate all land necessary for the railway between Omsk and Irkutsk; thereupon an order was issued that in future all questions concerning the acquisition of land by the Commission should be settled in a legal manner by the Council of the Empire. In order to lessen the cost of construction the Commission agreed to the free carriage of the necessary supply of wood from the forests of the Crown, whether in Eastern Siberia or in the governments of Tomsk and Tobolsk. A special system of police-soldiers was established both in the sections where the line was in course of construction, as also in the sections in which the line was already opened for traffic. In order to attract experienced and reliable workmen it was deemed expedient to extend the regulation of June 25th, 1886, concerning the remittance of journey money and cost of living, with few exceptions, to those workmen engaged in building the line from Chelyabinsk to Vladivostock, and at the same time to guarantee all rights and privileges of service to those engaged in these outlying districts. Moved by the desire to have in future a sufficient supply of special technical employés for service on the railway, the Commission resolved to open three technical "Railway Schools," in the towns of Omsk, Krassnoyarsk, and Chabarovsk. Mention must here be made of the grant made to fit out a special "Church Car," which has ministered to the spiritual needs of the officials and workmen throughout the extent of line opened; and also of the resolve of the Commission to prepare a panorama of the entire Siberian Railway, to be exhibited at the Paris Exhibition of 1900.

*The progress of the work of construction.*—As the Commission was entrusted with the general conduct of the work of constructing the Siberian Railway, it was deemed to be essential for the proper fulfilment of this task that regular reports of the progress of the work should be drawn up, whereby an idea might be gained of the rate of progress, and also of the fitness of the various material used. But as these reports did not prove to be sufficiently exhaustive, the Commission decided to obtain more accurate information on the spot with reference to the state of the work and the rate of progress, and due regard was paid as to the way in which the regulations and orders issued by the Central Administration were being executed along the line of railway. For this purpose a special Commission under the presidency of the Assistant-Minister of Communications was ordered to betake itself to Siberia in 1898 in order to examine the work of construction, and to the same end Prince Chilkov, Minister of Communications, made four journeys to Siberia. In order to form a complete idea of the colossal dimensions of the work undertaken by the Commission of the Siberian Railway, it is only necessary to read the following figures taken from the estimates for the work so far as it has been carried out. For the general extension of the Siberian line from Chelyabinsk to Sretensk—exclusive of the line running round Lake Baikal—including the branch line to Tomsk and from Chabarovsk to Vladivostock, a distance of 4952 versts or 3301 miles, 89,106 dessiatines, or 245,100 acres, of land are required, and 14,612 dessiatines, or 40,183 acres, of forest are to be cut down; the earthworks to be carried out amount to 9,404,000 cubic fathoms, which will require no less than 19,000,000 days' work;

embankment slopes amount to more than 529,507 square fathoms; for draining the permanent way three miles of iron pipes are to be laid, and also about 16,000 cubic fathoms of stone conduits to be built; bridges are already built and to be built to the extent of 30½ miles, and they comprise nearly 8 miles of iron bridges, consisting of 90,000,000 lb. of ironwork and 46,000 cubic fathoms of masonry; sand will be used as ballast eventually to the amount of 700,000 cubic fathoms; the sleepers will number 8,400,000; the arrangements for keeping the line clear of snow are 568 miles in length; telegraph poles number 118,000, and 6666 miles of telegraph wire will be used; the houses of the gatekeepers along the line would, if placed side by side, cover the space of 1½ dessiatine, or nearly 3 acres; the barracks cover a total area of 5½ dessiatines, or 15⅛ acres, the workshops 3½ dessiatines, or 9⅝ acres, and the dwelling houses 10 dessiatines, or nearly 28 acres. The total length of the various passenger platforms is reckoned at 7½ miles; water pipes are laid to the length of 159 miles; the total capacity of the water tanks amounts to nearly 700,000 vedros, or 1,633,333 gallons; the weight of the rails and fastenings will be 684,000,000 lb. Lastly, if the various rolling stock of the Siberian Railway were to be placed so as to form one train, the length of it would be 54 miles, and the loading capacity of the goods wagons and platforms is estimated at 198,000,000 lb. During the working period of 1897, 2,329,000 cubic fathoms of earthworks were specially executed, 680 miles of rails laid, and 569 miles of the line were laid in ballast. Altogether, at the present moment, 2839 miles of rails are laid, of which total 2399 miles belong to the Siberian Railway properly so called, and exclusive of the section round Lake Baikal, 289 miles belong to the line from Perm to Kotlas, and 151 miles to the line connecting Ekaterinburg with Chelyabinsk. The total length of the various lines that have yet to be laid down is 4267 miles.

*The cost of construction of the railway and also of the subsidiary undertakings connected therewith.*—The cost of constructing the whole Siberian Railway, exclusive of the line round Lake Baikal, amounts to £38,248,450, of which sum £27,881,880 were allotted in making the line from Chelyabinsk to Sretensk, the branch line to Tomsk and the line from Chabarovsk to Vladivostock. In addition to the funds assigned for the leading sections of the line, *i.e.*, the Central and Western Siberian, the Ekaterinburg and Chelyabinsk and the South Ussuri sections, the sum of £1,443,290 was assigned for working various subsidiary undertakings connected with those sections of the line, and principally in colonising the territory lying along the line of route and in developing the trade and industry of Siberia; the average outlay for this purpose was £410 for every 1100 yards of line. This amount was increased by £814,430 in 1897 for the same purposes on the sections belonging to the second division, *i.e.*, for developing the North-Ussuri and Trans-Baikal lines, the branch line from Irkutsk to Lake Baikal and the line forming the connection with the Eastern Chinese Railway. Thus, the total outlay upon these subsidiary undertakings amounted to £2,257,720. In view of the fact that from the very commencement of the line the Imperial wish was most strictly adhered to, viz., that the Trans-Siberian Railway was to be built by Russian workmen and out of Russian materials, this immense outlay of money will most certainly be of the utmost advantage in raising and developing the productive powers and capabilities of the Russian Empire. From year to year there is a great increase in the number of workmen arriving from the central governments of European Russia to find remunerative work in building the Siberian line, and the presence of this class of workmen will be of the greatest aid in gradually developing the wonderful resources of Asiatic Russia.

*The preparation of districts for colonisation by settlers.*—In order to meet the requirements of settlers in the matter of land, the Commission took steps to acquire available property suitable for forming settlements so as to bring into existence a "Land Colonisation Fund," that should meet the demands of settlers. As the lack of proper surveying instruments was soon felt to operate against the due carrying out of this project, since the local authorities were unable to supply a sufficient quantity for the task, the Ministry of the Imperial Domains organised special temporary sections of officials to undertake the settlement of the districts to serve as settlements, and also to carry out the necessary land survey. These sections were guided by an Imperial Decree dated June 25th, 1893, and styled, "Temporary Rules for forming Settlements and Reserve Districts along the Siberian Railway." This decree was drawn up with the idea of encouraging emigration from European Russia, and also of dealing with future claims upon the use of the land that might arise on the part of the Empire. These rules were guided by the general principle that possession of their land should be guaranteed to existing settlers in Siberia, even in cases of nominal ownership. As a consequence of this, the formation of settlements and reserve districts was permitted only in those regions in which there was really a superabundant supply of land, and not only the "Free Crown Lands," but also the lands in the absolute occupation of the Crown and peasants alike were made use of in forming the settlements and reserves. In the case of the property of the peasants, however, this land was taken from them only in those villages in which the share of the Crown lands falling to the lot of every male peasant exceeded forty-two acres. The examination and confirmation of the proposals of the leaders of these sections appointed to arrange the new settlements were entrusted to temporary local committees. Land in the governments of Tobolsk and Tomsk has always been sought after by settlers, and the attention of the temporary special sections charged with the question of colonising Siberia was at once turned to these two governments. The activity of the sections increased more and more as time went on, and the working staff had to be added to, and the sphere of their labours was extended.

*The colonisation of the Taiga and the Urmanes.*—The increased activity of the sections for organising settlements and reserves soon made it clear that the available and suitable pieces of land had been used up in the more cultivated parts of Siberia. Nevertheless the colonisation movement continued to grow, and there was a corresponding demand for unappropriated land for the use of settlers. Under these circumstances the question was raised as to forming colonies in the uncultivated forest districts of the so-called Taiga and Urman regions, so far as they come within the range of the Siberian Railway. The first attempt to form a settlement in the Taiga, which lies nearest to the railway line, showed that the allotment of land to settlers in this district would not give the desired results in all cases, as the felling of the trees and clearing the land were much beyond the strength of the settlers. In addition to this, it was manifest that the Taiga, by reason of the fact that its colonisation had always been perfectly free from every kind of restraint from all regulations, had from of old failed in some degree to attract immigrants from European Russia, as they avoided the hard conditions of life in such very sparsely-populated regions; while the old peasant settlers in Siberia were attracted to the Taiga by a desire to lead a life free from all restraint in a region that was perfectly unfettered by the usual regulations. This immigration of the old settlers of Siberia into the Taiga is of great importance from the point of view of colonisation, as these settlers form the most suitable element for cultivating and developing that district, and in this way there will be, on the one hand, an increase in the area of cultivated land, while on the other hand the land set at liberty by this emigration of Siberian peasants was made use of for the formation of settlements.

For the purpose of developing and organising the colonisation of the Taiga, special regulations to that end were laid down for settlers in the Taiga districts in the Governments of Tobolsk and Tomsk, and in the General-Government of Irkutsk. At the same time the Commission resolved to undertake a thorough exploration of the Taiga area with a view to determining its limits, and to setting aside within those limits especially valuable stretches of forest and woodland in the future interests of the Forest Department of the Crown; such reserves are not to be open to settlement by colonists. The staff of the sections was increased by the addition of officials employed in the Forest Department. With the exception of the forests reserved to the Crown, the whole area of the Taiga has, after examination, been given up to free settlement alike to immigrants from European Russia and to Siberian peasants of long standing, and to these settlers special concessions have been made as regards the payment of Crown taxes and the discharge of the customary services of defence.

The exploration of the Taiga thus undertaken by the officials of the temporary sections has shown that there exists a considerable amount of land in the Taiga, and also in the neighbouring districts already occupied by settlers, which from the state of the land and other natural conditions is suitable for colonisation upon the general principle laid down in the Regulations of June 25th, 1893. Therefore a large proportion of this land was turned into settlements and reserved districts. Especially good results were obtained in this respect in the Tara district in the Government of Tobolsk, which is very rich in Urmanes along the courses of the rivers Shisha and Tuya, tributaries of the Irtish that flows in a north-western direction from Omsk to Tobolsk. During 1897 forty-five districts of settlement were established, and they were all occupied in the same year by settlers and reconnoitring parties. In addition to these forty-five districts of settlement in the district thus referred to, an area was also set apart there for the purposes of future colonisation, and this reserved area is 100,000 dessiatines, or 277,000 acres in extent.

*(To be continued.)*

## OIL ENGINES.—CAPITAINE *v.* DIESEL.

IN a paper read by Herr E. Capitaine at the meeting of the Verein deutscher Ingénieure, at Frankfort, in April last, the theory propounded by Herr Diesel and the results he has obtained are closely criticised. Diesel's contributions to engineering science consist of a theory of the utilisation of heat for motive power, explained in a small book, "Theorie und Konstruktion eines rationnellen Wärmemotors," an English translation of which is published by Spon. This theory has been embodied in a two-cycle explosion oil engine, an account of which, together with a report on some very economical trials made on it, was published in our columns October 16th, 1897. Hitherto the theory has been represented only by the oil engine, although Herr Diesel professes in the future to be able to utilise lighting and power gas, and even powdered coal in a cylinder.

The central idea of the Diesel theory is the adiabatic compression of air in the motor cylinder of an engine in such a way and to such an extent, that the admission and spontaneous combustion of the charge, which take place at the moment of highest compression and during part of the following expansion, do not produce any increase of temperature. In other words, Diesel aims at combustion at constant temperature. The term "constant temperature" must here be taken in a limited sense, unless we suppose that the whole mass of gas shut up in the combustion space is perfectly homogeneous. Herr Capitaine, who is an advocate of the theory of stratification, thinks there must be a considerable rise in temperature in that part of the cylinder where the combustible burns in the compressed air. The air in excess, which does not enter into the process of combustion, will, on the other hand, undergo a great fall in temperature, because of its simultaneous expansion. Diesel's object is to obtain the maximum temperature of the cycle only by compression of the air, but if this aim is not realised such differences must exist. The limits of this maximum temperature are prescribed by the phenomena of dissociation; but according to Diesel, this temperature of dissociation is never attained in theory or practice, the working cycle being carried out at any given temperature. Diesel maintains that in all processes for converting heat into work except his own, the temperature of combustion is produced after ignition, during and by combustion. But in the heat cycle proposed by him the temperature of combustion is produced before and independently of combustion, by mechanical compression of air. This temperature of combustion may, he says, be varied at will.

Capitaine argues that the maximum temperature of combustion here spoken of is not maintained throughout the cylinder. He supposes the case of a cubic metre of air compressed in a cylinder to a temperature of 107 deg. Cent., or 2·7 atmospheres. The temperature of ignition of petroleum is assumed to be 100 deg. Cent.—it is generally lower. Into this air, at a temperature of 107 deg. Cent., a fine jet of pulverised oil is injected, ignites, and burns. But as a jet of gas once lit in a room will burn without greatly raising the temperature of the surrounding air, so this small jet of finely pulverised oil may, he maintains, burn in the centre of the large mass of compressed air, without producing a high temperature of the whole charge. Granting that combustion does take place, as Diesel says, at the end of compression and beginning of expansion, nevertheless, according to Capitaine, the quantity of petroleum burnt per stroke is so small, that the heat developed by it does not suffice to cover the losses of heat produced by expansion. Thus the total mass of gas and air will have a temperature below 100 deg. Cent. at one-third of the stroke, and will continue to decrease in temperature without hindering the combustion of the jet of oil spray, which may even burn after expansion has fallen to atmospheric pressure. At the actual place in the mass of gas where combustion is carried out, the temperature will be over 1000 deg. Cent., but this will not affect Diesel's alleged temperature of combustion, which is the mean temperature throughout the cylinder, or what he calls the "maximum temperature of the cycle." It is impossible that this temperature can throughout the stroke, as Diesel maintains, be above the temperature of ignition. Thus Capitaine seeks to demonstrate that the central idea of the Diesel theory, namely, the production of a temperature of combustion by compression only, and its maintenance during the stroke, is erroneous. The attainment of a high temperature by compression is no novelty, and Capitaine takes objection to Diesel's claim to have introduced a process, which reverses all the views hitherto held respecting combustion in a motor cylinder.

Coming next to examine the Diesel theory, as set forth in his engine, both Diesel and Professor Schröter consider that this engine truly represents it. It is important, therefore, to determine what the theory is. The Diesel working cycle may in its essentials be summed up: Firstly, as the production of the maximum temperature of the cycle, not by and during combustion, but before and independently of it, by mechanical compression of air. Secondly, the gradual admission of the pulverised oil into the highly compressed and heated air during part of the stroke, without rise in temperature of the charge, the curve of combustion being isothermal. To ensure this, combustion must not be left to itself, but be accurately regulated throughout the stroke. Thirdly, the careful choice of the quantity of air required for combustion in proportion to the heating value of the fuel, the temperature of compression, *i.e.*, of combustion being so regulated, that the engine will work without a water-cooling jacket.

According to Capitaine, the Diesel oil engine fails in several respects to carry out this theoretical cycle. The facts supplied by Diesel himself and Professor Schröter during the trials seem to show, that combustion produces a temperature twice as high as the temperature of compression; further, that the combustible burns first at constant volume, then at constant pressure, and lastly, at constant temperature; and, finally, that whatever the quantity of air admitted, the cylinder must be cooled, and thus the same quantity of heat is carried off as in an ordinary explosion engine.

This discrepancy between theory and practice is shown by Capitaine in a tabular form in his original paper. It cannot be denied that the divergence is somewhat marked, though possibly a reason for it may be found in Professor Meyer's assertion, in the *Zeitschrift des Vereines deutscher Ingénieure*, that the Diesel cycle of work, as deduced from his theory, would, if realised, give a bad mechanical efficiency. Diesel, however, still maintains that he has adhered to his theory in the engine, but he proceeds to shift his ground by saying that the complete theoretical diagram, indicating a rise in pressure of 70 atmospheres, cannot be obtained in practice. The highest point of the diagram is always more or less rounded, and the expansion curve varies from the strict isothermal. It is, he declares, of positive advantage not to carry the diagram to its extreme vertical limit of pressure; that is, to compress the air only to 30 atmospheres, or a temperature of 500 deg. Cent. The area of work obtained for the higher compression is very small, and by reducing the diagram compression is kept within more practical limits.

So far Diesel's argument is clear. It is more difficult to follow him when he says that compression may be arrested at will; in other words, the diagram may be varied by introducing the oil at any point of the compression line. Against this Capitaine urges that a diagram which is altered in its most essential particulars can no longer be identified with the theoretical. How, he asks, can compression be checked at 2, 4, 8, 15, or 30 atmospheres, and how can combustion be started during compression? Even if it were possible thus to evolve the practical out of the theoretical diagram, we are still confronted with the difficulty that the temperature during combustion is doubled, whereas the essence of the Diesel theory is that combustion takes place at constant

temperature, and the maximum temperature is produced by compression only.

Nor is Diesel's third condition more satisfactorily complied with, namely, that in his heat engine no cooling jacket is necessary. A water jacket was certainly required in the oil engine tested by Professor Schröter, but Diesel says that it was added later, for practical reasons, because it was thereby found possible to obtain more power in the same cylinder. He has thus laid himself open to controversy, for he originally asserted that the water jacket in a combustion engine is the principal obstacle to the realisation of a higher efficiency. Now he says that in all engines for converting heat into work, a certain quantity of heat must be carried off, as in the condenser of a steam engine, or the water jacket and the exhaust to atmosphere of a combustion motor. These two sources of waste represent the heat necessarily withdrawn from the working cycle, to carry it out at all. Hence a water jacket is not an unavoidable evil, but is required even in theory. All efforts to diminish this loss of heat must clearly fail, and are as futile as the attempts to reduce the quantity of injection water in the condenser of a steam engine. These views are at variance with Diesel's theory, and his comparison of the cooling water in an explosion engine to the condensation water in a steam engine is not satisfactory.

Capitaine next attacks Diesel on the ground of priority of invention. He taxes him with handling the subject as though there had never previously been an engine in which the combustible was gradually introduced into compressed air at the maximum pressure, burned without any marked rise in pressure, and the gases of combustion were then expanded. Such an engine is described in Otto Köhler's "Theorie der Gas Motoren," pages 40 to 43. Köhler's remarks are noticed and commended by Diesel, but he expressly says that his engine is the first of its kind, though he admits that some of his requisites may be found in other books. Into the question how far the claims to originality of the Diesel theory are affected by Köhler's publication Capitaine does not enter, since, according to him, the characteristic features of the theory are wanting in the engine. His contention is that no new type of motor has been produced, but that Diesel's chief merit consists in showing that with a certain class of engine, if a greater degree of compression is used, a higher thermal efficiency can be obtained. But this, from Capitaine's point of view, does not constitute a right to protect by patent the manufacture of an engine in which air is adiabatically compressed, and the combustible gradually injected into it, before or after the dead point.

Diesel's patent dates February, 1892. In May, 1891, Capitaine, it appears, took out two patents for an engine burning pulverised heavy oil injected into compressed air in a particular way. This engine was made in 1891 by Swiderski, of Leipzig, and drawings of it are given in Capitaine's paper. To obtain high compression of air for the charge, the size of the combustion space was reduced. The oil was injected by a pump as the crank passed the inner dead point, and the time of admission and quantity of oil injected were regulated by the governor, the amount of compressed air being always the same. By proportioning the size of the compression space to the cylinder diameter, and adjusting the ratio of the latter to the stroke, according to the usual scale of dimensions, the air was compressed to about 12 atmospheres = 300 deg. Cent. The higher the compression the shorter was the period of admission. The diagrams obtained from this engine resemble those described by Diesel, and taken from his motor. Capitaine says the air may be compressed to 30 atmospheres, but he did not succeed in obtaining even half this degree of compression.

The engine based upon the Capitaine patents was a two-cycle, with pump and motor cylinders, and in some of its details, and especially in the cleansing of the cylinder by a "scavenger" blast of air, resembled the Benz. The front part of the working piston forced the air into a receiver, from which it was sent on to the motor cylinder by an air pump, driven from a second crank. The liquid combustible was injected into the compressed air, and ignited gradually as it entered. A kind of "sheaf of flame" was thus supposed to be formed in the compressed air, and the maximum pressure of compression was not much increased during combustion. This engine was designed to utilise heavy Russian oil residuum, which, as is known, gives a good heat efficiency when burnt in an engine. Heavy oil could not be used in the original Capitaine engine, and it was only after many attempts that the inventor succeeded in breaking up and burning the oil as spray. The consumption of oil in the modified engine was 0·4 kilo.—0·88 lb.—per B.H.P. hour, and the only difficulty experienced was an occasional tarry deposit in the cylinder. The combustible burnt spontaneously at a pressure of only three atmospheres of compressed air, thus proving that the requisite temperature of combustion was produced by compression only, though close to the flame the temperature was much higher.

The development of this motor was hindered, it appears, by want of means. Diesel has been fortunate in obtaining sufficient pecuniary support through several able coadjutors, to produce his engine. His numerous experiments, extending over several years, have established the fact that the present practical limit of air compressio is between 30 and 40 atmospheres, and he has actually succeeded in obtaining these pressures. Capitaine could only reach a pressure of 15 atmospheres in his engine by prematurely closing the exhaust valve, although he knew that a higher pressure was desirable. The compression space in the Diesel engine is half that in the Capitaine, and this, according to Capitaine, constitutes the sole difference between the two motors.

It is, however, one thing to know, as most writers on the subject admit, that the attainment of a high degree of compression is one of the essentials to improvements in explosion engines, and another to realise the idea in practice. Capitaine stated in his patent that a small compression space, *i.e.*, a high degree of compression, ought to be one of the chief aims of inventors, but he was not able to take steps to achieve it. In Diesel's engine the practical limits of compression are attained with the ordinary methods of construction. Possibly he may set his claims to the discovery of a new theory too high, but in any case the merit cannot be denied him of having, like Otto, succeeded in embodying, in a practical working oil engine, ideas which had hitherto existed only on paper.

Coming now to consider the actual process of combustion, it is well known, and Diesel himself admits, that the chemical process requires for its completion a certain time, usually so short that it may be neglected. If, however, the combustible has to be introduced in a liquid or solid state, vaporised, and the molecules mixed with the oxygen molecules required for their ignition, the process will be more lengthy. The time will then depend on the nature of the combustible, its complete mixture with the air, the amount of oxygen contained in the mixture, degree of compression, &c. In oil engines pressures of 20 atmospheres and more are attained by explosion, if the mixture is previously compressed to only 4 atmospheres. It burns at a mean pressure of 12 atmospheres, or a temperature of about 300 deg. Cent., as against 500 deg. Cent. in the Diesel engine. This we can understand, if we assume that the first particles of combustible burn after ignition at 4 atmospheres pressure, and the last at the maximum pressure of 20 atmospheres.

On the question of the pressures and temperatures of combustion in an engine cylinder Herr Capitaine is an authority, and his criticisms of the Diesel motor in this respect are valuable. The rapid rise in pressure, he says, must be attributed to the inflammability of the petroleum. Even if the mass of gas is at 20 atmospheres pressure and a correspondingly high temperature, if an excess of air is present, and the charge thoroughly mixed, "after-combustion" nevertheless takes place. Every engineer knows that this produces a diminution in the area of work; for the highest efficiency combustion should be carried out at the maximum pressure and temperature. Many years ago Körting recommended that the gases during combustion should be thoroughly stirred and mixed, to accelerate the process. Since even at pressures of 20 atmospheres "after-combustion" in explosion engines can be verified, a combustible introduced as a liquid into the air requires an extremely violent agitation of the mass of gas, to prevent retarded combustion. At a pressure of 30 atmospheres the molecules of oxygen are closely packed together, and this circumstance, together with the relatively high initial temperature of the charge—about 500 deg. Cent.—must tend to hasten combustion. Too much weight should not, however, be attached to these conditions.

With heavy rock oil, which is difficult to brake up and vaporise, the time which elapses between its admission to the combustion chamber and complete combustion will be still longer. It is impossible, Capitaine says, to believe, as Diesel asserts, that the two processes are simultaneous. According to Diesel the combustible is introduced from the dead point onwards so gradually that, the gases expanding meanwhile, combustion takes place without appreciable rise in temperature and pressure, and expansion continues after admission is cut off. From these and other expressions it is clear that Diesel proposes to regulate combustion during its whole course, and to cause the combustible to burn by degrees, as it is admitted. Such, in Capitaine's opinion, cannot be the case. The oil enters the combustion chamber of the Diesel engine with the air for spraying it, at a pressure of several atmospheres, and no one can tell how it moves with the air. The diagrams show the progress of combustion, but not the admission of the combustible during the stroke. Capitaine maintains that in his engine the admission of the charge is more carefully regulated.

With regard to the transmission of heat from the hot gases to the cooler walls, we have to consider not only the differences of temperature, nature of the cooled surfaces, and time per stroke, but also the way in which the particles of gas are brought in contact with the cold walls. If we imagine a stationary mass of gas at 1000 deg. Cent. shut into a vessel, the walls of which are at 100 deg. Cent., and then suppose that this same mass is in violent motion, so that almost every one of the highly-heated gas molecules is brought into contact with the walls, it will be clear that with the greater movement of the gas a larger quantity of heat must pass to the walls than when the gas is stationary. We may also assume that, as long as the temperature of dissociation is not reached, the continual churning up of the gases while burning must have a retarding effect upon the process of combustion. Here again Capitaine considers that the process of mixing the two streams of oil and air is better carried out in his engine than in the Diesel, as it takes place almost wholly in the centre of the mass, and not against the walls.

Although Diesel affirms that his engine can be driven equally well with lighting gas, it has hitherto been found impossible to work it with anything but oil. The most favourable proportions between the combustible and the size of the engine have been chosen, yet Professor Meyer says that in the Diesel oil motor not more heat is turned into actual work than in a good gas engine. It remains to be seen whether he will obtain as good results with lighting gas, or with power or poor gas. With the latter a gas pump will be required, and according to Capitaine the negative work will absorb nearly all the heat of compression of the gas. The pressure of the gas stored in the reservoir cannot be maintained as it passes to the cylinder unless, as in the Capitaine engine, the pump is in direct communication with the bottom of the cylinder. If much of the heat of compression is withdrawn from the gas, its relatively large and cold volume will reduce the temperature of the air. Compression must be increased to procure ignition of the gas, and this again may have a bad effect upon the mechanical efficiency.

The only Diesel engine on which trials have hitherto been made is one of 20-horse power, and Capitaine asserts that a Diesel petroleum motor of 4-horse power would probably not surpass existing oil engines in economy. The 4-horse power Capitaine engines consume 0·32 kilo. (0·70 lb.) of oil per brake horse-power hour, while the 20-horse power Diesel engine burns 0·210 kilo. (0·46 lb.) per brake horse-power hour. The comparative economy of the two engines, if their relative powers be considered, is not, in his opinion, very different. In the Capitaine oil engine tested at Meaux in 1894 the consumption was 0·59 lb. per brake horse-power hour, being the lowest of all the engines entered for competition. In the *Zeitschrift des Vereines deutscher Ingénieure*, 1897, pp. 819 and 848, a table by Professor Schröter and Herr Diesel will be found, showing the comparative consumption of petroleum in the different oil engines. According to this table a Capitaine engine gave the best economy next to the Diesel. It is impossible to form a correct judgment of the relative merits of the two engines until more tests are available. It may be noted, however, that the brake efficiency in the Diesel motor is not very good, a defect which will doubtless be remedied in future constructions.

In the discussion on Capitaine's paper, Professor Gutermuth considered that the question turned principally on patent rights. He admitted, however, that Diesel's theoretical conditions had not been wholly fulfilled. He did not share Diesel's opinion that the engine would succeed as a small power motor, and as yet it had given no good results as a gas engine. Nevertheless, he maintained that the Diesel theory was correct, and was fairly represented in his engine, a view which was not shared by others present.

To sum up the matter, the novel points in the Diesel motor are perhaps not so many as its admirers claim for it. To start an explosion engine by compressed air is a method familiar to most engineers, as also to regulate its working by injecting varying quantities of combustible into compressed air, thus varying also the amount of air in excess. But it is scarcely correct to assert, as Capitaine does, that its sole claim to originality consists in diminishing the compression space of an oil engine. We cannot go into the question of the commercial competition between these well-known inventors. But the fact must not be overlooked that Diesel has produced a practical engine, giving the highest heat efficiency and lowest consumption of combustible yet realised, namely, 0·52 lb. of oil per brake horse-power per hour at full power, with a 20-horse-power engine; actual heat turned into work on the brake, 26 per cent.; and heat turned into indicated work, 34½ per cent.

## THE EVOLUTION OF SMALL ARMS.

AT the Royal United Service Institution on Wednesday, June 29th last, Lieut.-Col. W. N. Lockyer, Chief Inspector of Small Arms, read a paper on the "Evolution of Small Arms." He traced the development of the present magazine breech-loading rifle from the first adoption of the breech-loading system in the Snider converted rifle. It is not necessary to follow follow this, though we may note in passing the curious changes in opinion that took place in the minds of the authorities. It has been stated, though not by the lecturer, that the first breech-loading small arm put forward was objected to on three grounds: (1) That it fired too rapidly, that is, more than five times per minute; (2) that the charge was in a metal case; (3) that it carried its own ignition. Before many years an invitation for competitive designs was put out, and among the conditions to be fulfilled were:—(1) The rate of fire must exceed five rounds per minute; (2) the charge must be in a metal case; and (3) it must contain its own ignition. Without vouching for the absolute accuracy of this, we may add positively the fact that the special feature that was held to condemn a rifle when the Martini-Henry rifle was adopted was bolt action, and now bolt action has come in in our own and most foreign service rifles. The special feature of Colonel Lockyer's lecture was his advocacy of a universal weapon for all services, the weapon recommended being the carbine with a triangular bayonet. Automatic guns were held by the lecturer to be a necessary adjunct to infantry fire, though not the strongest fully develop 1 yet. He then passed on to the question of inspection of arms. In discussion the lecturer's preference for the triangular bayonet received support.

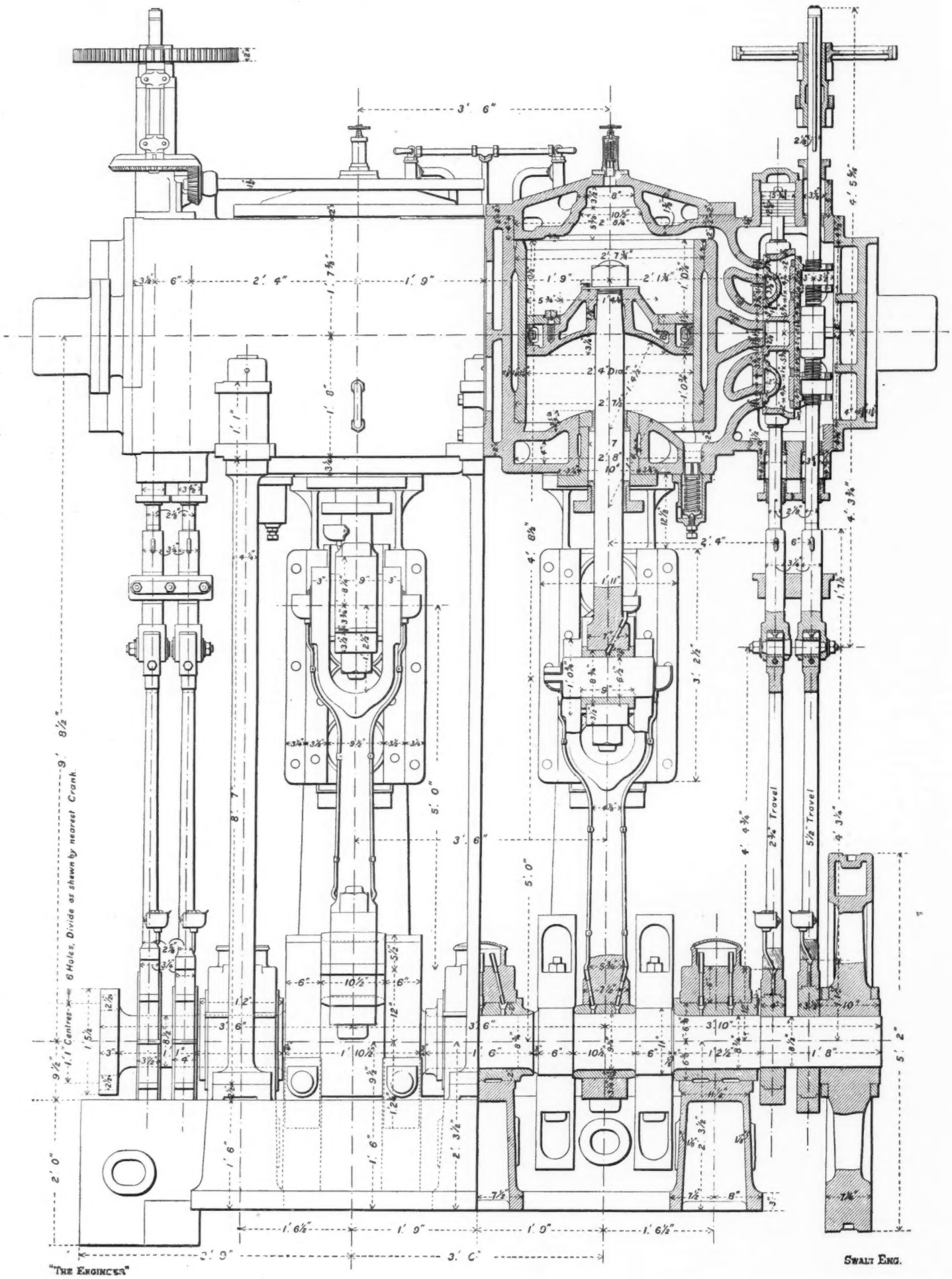
We would take this opportunity of making an explanation or correction of a paragraph which we gave from the *Times* in our last issue with regard to the service bullet. It is not correct to speak of the new bullet as having a hollow conical nickel head and only containing lead in the base. The lead runs up to the point inside the nickel to the same extent as the lead in the Snider-Boxer bullet. That is to say, a bullet with the ordinary form of point has a small cylindrical hollow made in the axis, the nickel being run to the edge, and a disc of nickel being pressed down to the bottom of the cylindrical hollow. As we have often pointed out, it is a matter of some delicacy to make a bullet spread sufficiently to give it stopping power and shock, and yet not to fly and form what is termed a cruel bullet. The Webley pistol bullet has a shallow hollow in front as well as in base to fulfil this object.

CORK AS A PAVING MATERIAL.—It may not be generally known that cork has been somewhat extensively tested in different parts of the kingdom for some years past as a material suitable for road pavements. Ground up into small particles mixed with bitumen and a suitable fibrous material, when compressed into blocks under a high pressure—600 lb. per square inch—this material has been found to produce a medium for road pavements which has given excellent results under different conditions. The material is tough, cohesive, and elastic without being too easily compressed or indented. Not only does it afford a good foothold, but it is practically non-absorbent and noiseless. It is laid in cakes very much in the same manner as wood blocks, that is, on a cement concrete foundation of a depth suitable to the traffic to be encountered, and the jointing material is bitumen. The Cork Pavement Company, Limited, 21, St. Mary Axe, E.C., have applied a large amount of this pavement, not only in the metropolis, but also in other parts of the kingdom with, it is claimed, highly satisfactory results. At Liverpool-street Station, London, several roadways have been in use for a number of years paved with cork, and the results are said to have been all that need be desired.

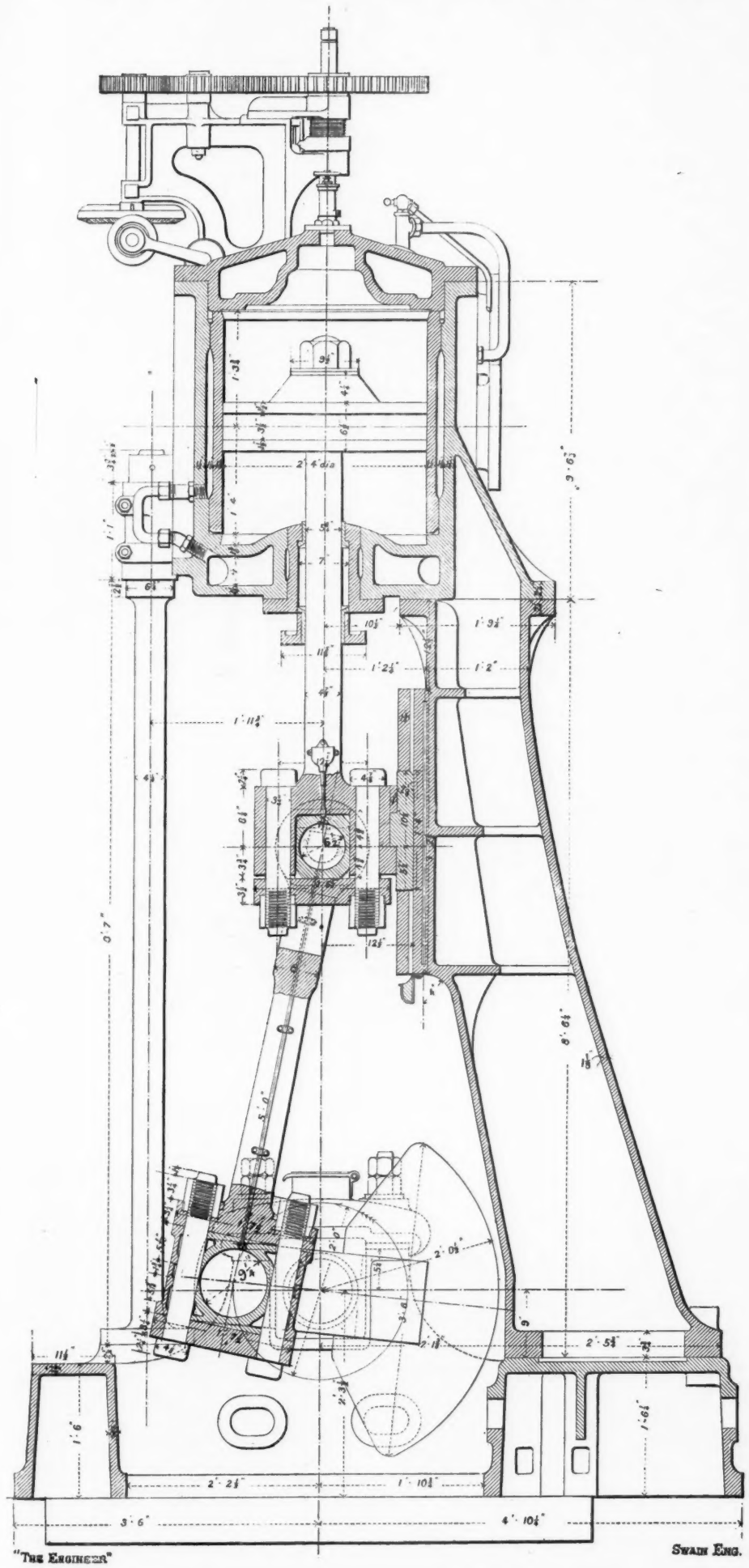
# PUMPING ENGINES, GLASGOW GRAVING DOCKS

MESSRS. ANDREW BARCLAY, SONS, AND CO., LIMITED, KILMARNOCK, ENGINEERS

(*For description see page* 29.)



## PUMPING ENGINES, GLASGOW GRAVING DOCKS




## THE NEW GRAVING DOCK OF THE CLYDE NAVIGATION TRUST.

No. II.

IN our impression for May 20th we published a general description of the new graving dock at Glasgow, and on June 17th we published an engraving showing the inside of the engine-house. We now give sectional views of the pumping engines on pages 28 and 32. The pumping arrangements may be briefly described. As will be seen from the plan in our impression for May 20th, the outer division of the dock is filled by two culverts, each 7ft. 4in. high by 4ft. wide, the south one leading from an 11ft. 6in. high by 8ft. wide main discharge culvert led through the south wing wall, and the north one led through the north wing wall, side walls, and end wall of the caisson chamber; both discharging into the dock through the inner side walls of the entrance. The inner division is filled from the outer divisions by two culverts, 7ft. 4in. high by 4ft. wide, carried through the side walls of the inner entrance. A loop culvert, 6ft. by 3½ft., leads from the main discharge culvert into the sump under the pumping-engine house to increase the rapidity of the filling of the dock. The sluices on the various culverts easily control and direct the discharge into either division.

For emptying the dock an entirely independent pumping installation has had to be provided; the depth being about 4ft. greater than in the case of docks No. 1 and 2. The pumping-house, as will be seen from the plan, is situated on the south side of dock, close to the outer entrance. It is founded on concrete and brickwork, extending 53ft. below cope level. A sump, 61ft. long by 12ft. wide and 11ft. high, inverted on the floor, arched on the roof, and lined with vitrified blue bricks, is constructed under the engine-house, the floor of invert at the centre being 47ft. below level of cope of entrance walls. The main water inlet to the sump from the dock is a culvert 9ft. by 6ft., carried through the south side of the dock, close to the inside of the outer entrance, and connected to a large opening in the floor and inside wall of dock, supplemented by a culvert 6ft. diameter led through the brickwork of the south side of the body of the dock to the outer end of south entrance wall of inner division, where it joins the 7ft. 4in. by 4ft. filling culvert, already described. From the inside of the inner entrance it is again altered to 6ft. diameter, and carried along the south wall of the body of the dock up to nearly the upper end of the inner division, where a granite coped opening is provided in the floor of the dock. From the sump a 6ft. diameter cast iron pipe is carried across under the floor of the dock and continued in brickwork in the body of the north wall of the dock to the outside of the north wall of the inner entrance, where it also joins the 7ft. 4in. by 4ft. filling culvert already mentioned.

From the upper end of the latter culvert a 30in. diameter culvert is carried along in the brickwork of the body of the dock to nearly opposite the inlet for the discharge culvert in floor of dock on opposite side, and thence carried in a 30in. bore cast iron pipe to the floor of No. 2 graving dock for the purpose of more speedily emptying it when necessity arises. For enabling this pipe to be laid, the space between the back of the side walls of the two docks, 127ft. in length, had to be tunnelled. A culvert 3ft. in diameter extends across the floor from the main inlet to the pump to the north gutter, for draining the floor of that section of the dock. A casti ron pipe, 6in. bore, is led from the caisson chamber inside and close to the check for the portable timber dam across the mouth of the chamber into the adjoining 6ft. culvert in side wall of dock to enable the chamber to be pumped dry when required.

All the exposed mouths of culverts are of granite. The area of the seven inlets to the culverts formed in the sides and floor of the dock is 730 square feet. Each inlet is protected by strong wrought iron bar gratings, covered with wire netting to prevent chips and other *débris* finding their way to the pumps. Leading up from the culverts in each side of the body of the dock to the surface of the ground, are thirty fire-clay pipes 6in. bore, placed at regular intervals, which permit the escape of air from the culverts when water is admitted. These pipes at the surface are covered and protected by cast iron gratings placed close behind the cope. For controlling the operations of filling and emptying there are in the various culverts fourteen cast iron framed and gun-metal-faced hydraulic sluices, ranging from 10ft. high by 6ft. broad to 3ft. diameter. All this work we shall illustrate in a succeeding impression.

The centrifugal pumps are driven by simple inverted double-cylinder engines, with pistons 28in. diameter and 24in. stroke. The distribution is effected by double-ported valves, with Meyer slides on the back, which are adjustable by hand by means of toothed gearing. The valves are balanced by two pistons each, or four in all, in a way that will be best gathered from the plan on page 32. The whole of the machinery is excellent, and a glance at our fully-dimensioned drawing will show that metal has not been spared. The engines and pumps have given so far complete satisfaction.

## DOCKYARD NOTES.

THE substitute for naval manœuvres has already begun, the reserve squadron and the Channel fleet are collecting. A representative of the Navy League has discovered, what was already pretty well known, that "want of coal is not the real reason." We have already touched upon this matter, having pointed out how absurd is the idea that political reasons, and a consequent desire to economise coal, had anything to do with the Admiralty's decision. Avowed or not, the real reason is that manœuvres are not worth the expense. Nothing whatever has ever been learnt from these make-believe battles, or ever will be learnt until some very different system is evolved; further, they are unpopular with nearly every officer in the service. The operations of Captain Long in 1892 and the blockade of 1889 may possibly be argued as exceptions to the statement that nothing has ever been learnt by manœuvres, but that was long ago, and at best but a drop in the ocean. More than once the manœuvres would almost appear to have been deliberately arranged and "cooked," in order to prove to the public that there was or was not danger under such-and-such circumstances. In 1894, for instance, the manœuvres worked out to prove something about our Mediterranean fleet and its chances of a junction with the Channel before the two French fleets could join. It is difficult to believe that manœuvre rules have not been framed before now in order to show the public that torpedo boats cannot do much harm. We do not altogether attack this method of instructing the public, but it is costly. It might be well, too, if the framers of manœuvres could get one elementary idea into their heads, and that is, that war does not consist in making junctions of fleets. Both we and our enemies would surely have the sense to do this so far as possible before the war broke out, not after. For instance, if war was really imminent with France, we should not leave the Mediterranean fleet at Malta and the Channel fleet at Portland. Such reinforcement as we deemed necessary we should at once make. This attempt might produce the war, and it is conceivable that we might have a Government foolish enough to stay its hand on that account. It is, however, equally foolish to base our plans on such a supposition, or to expect that our enemies would be equally inane.

THEY manage these things better in France. In French manœuvres, not only is the fighting value in points assigned to each ship carefully thought out, but every ship is limited to a certain number of revolutions. Conditions likely to

occur in war are carefully thought out, so that there is a good deal more realism than with us.

To hark back to our manœuvres and the coal question, comparatively few people are aware of the huge amount of coal consumed by "lying in harbour." There are so many auxiliary engines and so forth to keep going, that a battleship of the Majestic class consumes something like 80 tons a week. At sea, on cruises, the consumption—week in, week out—is approximately 200 tons a week. There is an impression about that ships in harbour cost next to nothing in coal.

## LAUNCHES AT NEWCASTLE.

Events unprecedented in the history of shipbuilding have taken place last week at Newcastle-on-Tyne. Three warships were launched in one week from the yard of one firm. On Monday one cruiser, a vessel of 4200 tons, was sent down the ways; on the 5th inst. a training ship for the Chilian navy, of 2500 tons, was launched; and on the 6th inst. the fine belted cruiser for the Japanese Government was launched. The first of these was named by Miss Watts, Fourth of July. Her principal dimensions and armament are as follows:—

| | |
|---|---|
| Length | 380ft. |
| Breadth | 46ft. 6in. |
| Draught | 17ft. |
| Displacement | 4100 tons |
| Armament— | |
| Two 8in. quick-firing guns. | |
| Ten 4·7in. quick-firing guns. | |
| Sixteen 3-pounder quick-firing guns. | |
| Six 1-pounder quick-firing guns. | |
| Five torpedo tubes. | |

The speed of the vessel is to be 22½ knots. She is of much the same type as the Takasago, illustrated in our impression for June 3rd. Mr. Watts stated at the launch that the new cruiser differed from that vessel in a few unimportant particulars. The Takasago was a replica of the Yoshino, which distinguished herself in the Japanese war. Each of those vessels belonged to a large series of vessels of the protected cruiser class, including some forty vessels which had been built by their firm. The first vessel of her class was the Esmeralda, which was built in 1882 by that firm. The central features of that class, as enunciated by Lord Armstrong, were "great speed and nimbleness of movement, combined with great offensive power; with little or no side armour, but otherwise constructed to minimise the effect of projectiles." All the vessels of that class had had those qualities developed, and the vessel launched that day had had them developed to a very high degree.

The second ship launched was the Jeneral Baquedano, whose principal dimensions and armament are as follows:—

| | |
|---|---|
| Length | 240ft. |
| Breadth | 45ft. |
| Draught, mean | 18ft. |
| Displacement | 2500 tons |
| Armament— | |
| Four 4·7in. quick-fire guns. | |
| Two 12-pounder quick-fire guns. | |
| Two 6-pounder quick-fire guns. | |
| Two Maxims. | |
| One 18in. torpedo tube. | |
| Speed— | |
| With 1500 I.H.P., open stokeholds | 12 knots |

The third ship is the first-class armoured cruiser Tokiwa. On page 33 will be found a drawing of this ship as she will appear at sea when completed. Her principal dimensions and armament are as follows:—

| | |
|---|---|
| Length | 408ft. |
| Breadth | 67ft. |
| Draught, mean | 24ft. 4in. |
| Displacement | 9700 tons |
| Armament— | |
| Four 8in. quick-fire guns. | |
| Fourteen 6in. quick-fire guns. | |
| Twelve 12-pounder quick-fire guns. | |
| Seven 2½-pounder quick-fire guns. | |
| Five torpedo tubes. | |

These guns can be so trained that fifteen guns can fire directly ahead, viz.:—Two 8in. guns, four 6in. guns, six 12-pounder guns, two 2½-pounder guns, one torpedo. Fourteen guns can fire directly astern, viz.:—Two 8in. guns, four 6in. guns, six 12-pounder guns, two 2½-pounder guns; and twenty-five on either broadside, viz.:—Four 8in. guns, seven 6in. guns, six 12-pounder guns, six 2½-pounder guns, two torpedoes.

| | |
|---|---|
| Armour— | |
| Complete belt | 7in. to 3½in |
| Citadel | 5in. |
| Casemates | 4in. |
| Barbettes | 6in. |
| Conning tower | 14in. |
| Speed— | |
| With 18,000 I.H.P., forced draught | 21½ knots |
| With 13,000 I.H.P., open stokeholds | 20 knots |
| Coal supply— | |
| Normal | 600 tons |
| Full | 1200 tons |

## LAUNCH OF H.M.S. AMPHITRITE.

The Amphitrite cruiser was launched successfully on Tuesday from Messrs. Vickers, Sons, and Maxim's Naval Construction Works, at Barrow, in the presence of about 15,000 people. Mrs. Vickers, wife of the chairman of the firm, performed the naming ceremony. The proceedings passed off without the slightest hitch.

A luncheon was afterwards given, among those present being Sir William White, Director of Naval Construction, and Vice-Admiral Colomb. The Lord Mayor of Sheffield proposed, "The Navy, Army, and Reserve Forces." After several toasts had been proposed, Sir William White said that no design ever prepared in the Admiralty had been more carefully considered than the design of the Amphitrite class. It was the habit often to assume that designs sometimes came about in an accidental and casual manner. The candid critic in these days was sometimes called a naval expert, although why he did not know, but he could assure them that neither on the side of the policy represented in the design, and still less in the technical qualities which had to be embodied in the design, had such statements even a shadow of truth in them. It did not come about by accident that certain classes of ships were added to the Navy, or that they fulfilled the intention of their designers. It was an enormous responsibility, representing the greatest amount of labour, and not to be achieved successfully except by the most strenuous and continued effort on the part of those who had to undertake such responsibility. No one welcomed fair and honest criticism more than he did if the critic would have the manliness to put his name to the opinion he expressed, so that all the world might know who was speaking, and on what authority he spoke. But anonymous attacks, which not only affected a private firm, but the interests of the nation, were things beneath contempt. They found the loosest statements often made which could have no other object than to attract attention and cause sensation. Those matters ought not to be treated in any such way. It might be taken for granted, and was taken for granted by the thinking public of the country, that such a responsible body as the Board of Admiralty might be trusted in carrying out their work. It came to this—that every design prepared for a new class of ship in the Navy was prepared in the full light of day, and with a full knowledge of what was being done elsewhere, and with the intention of fulfilling specified duties. That was the simple truth, and when they heard the criticisms that had been passed on the Powerful, when they found that it was conveniently forgotten that the ship had not only done all that was promised at the time of her design but had exceeded that promise; and that, whereas it was said she must steam for thirty hours at 20 knots she steamed thirty hours at 21 knots; and, whereas it was said the maximum speed must be 22 knots, that she attained nearly 22½ knots; and, whereas it was said she had covered a certain distance at certain speeds, that she proved herself capable of doing more than was promised—when all those things had been tested with such thoroughness as was not approached in most cases in ships built for other navies—when such a record was made and only difficulties of a temporary nature occurred in testing the true qualities of the ship, it was not fair nor just criticism, nor was it proper treatment of so important a subject. He did not come there really to say that at all, but Mr. Vickers had led him on, and he was not at all sorry that he had said it. When they heard of crawling cruisers, poor crawling cruisers, going at 20 knots, and that a tortoise speed like that was not to be mentioned with some results one had heard of, he would like to see, not a comparison on paper, but a comparison in fact under similar conditions made between some of the crawling cruisers and ships with which they were not supposed to be mentioned on the same day. The truth was that the conditions of the trial, the time of the trial, and the oversight of the trial, were all matters which required to be dealt with and fully known before they could make any true comparison between different ships, and though he was not in any sense laying claim to infallibility, for he was getting too old for that, yet he did claim that on those matters the British public need not very much consider anonymous and unsupported and partial statements. Mr. Vickers had referred to the graceful appearance of the Amphitrite. He himself was not perhaps an impartial critic in such matters, but he did think she was the best-looking ship he had ever produced, although the artist would not look at it that way, simply because of the absence of masts and sails, which added beauty to the earlier vessels such as could never be approached in modern times. The artist now lamented that he had no masts or sails to make a picture of. He had not even smoke now with smokeless powder, and unless it happened to be during a coal strike in South Wales and some other coal had to be used. Sir William White then proposed "Success to Messrs. Vickers, Sons, and Maxim." He alluded to the remarkable development of the firm during the last few years. The firm was formerly renowned throughout the world for certain branches of manufacture. It was hardly more than ten years ago since Mr. Vickers and he talked over the possible undertaking of the manufacture of plate armour, and in that brief interval the firm had taken one of the highest places in that department and also in gun carriages, mountings, guns, and all munitions of war. Sir William White's speech was frequently applauded.

Mr. Albert Vickers responded to the toast.

## EXPRESS ENGINES, HIGHLAND RAILWAY.

We illustrate this week two fine passenger engines, designed by Mr. D. Jones, late locomotive superintendent of the Highland Railway. It is well known that the line is very difficult, with inclines of as much as 1 in 70 nearly eight miles long. There are sharp curves, and the trains are very heavy. To deal with this traffic Mr. Jones designed two types of engine, with outside cylinders, represented by the Sir George and the Loch Insh.

The dimensions of the first of these is given in the following table:—

| | | |
|---|---|---|
| Cylinders, 20in. diameter, 26in. stroke. Tractive force 165 lb. per lb. of effective cylinder pressure. | | |
| Weight on bogie | 14 tons, dia. of wheels, 3ft. 2in. | |
| ,, leading wheels, coupled | 13¾ ,, ,, ,, | 5ft. 3in. |
| ,, driving ,, ,, | 14½ ,, ,, ,, | 5ft. 3in. |
| ,, trailing ,, ,, | 14 ,, ,, ,, | 5ft. 3in. |
| ,, tender (with coal and water) | 36 ,, ,, ,, | 3ft. 9in. |
| ,, total | 92 tons | |
| Heating surface—Tubes | | 1559 sq. ft. |
| ,, ,, Fire-box | | 113·5 sq. ft. |
| ,, ,, Total | | 1672·5 sq. ft. |
| Fire-grate area | | 22·6 sq. ft. |
| Boiler pressure | | 175 lb. per sq. in. |
| Tender contents | | 3000 gals. water, 5 tons coal |
| Automatic vacuum brake. | | |

And that of the second in the following table:—

| | | |
|---|---|---|
| Cylinders, 19in. diameter, 24in. stroke. Tractive force 115 lb. per lb. of effective cylinder pressure. | | |
| Weight on bogie | 17½ tons, dia. of wheels, 3ft. 3in. | |
| ,, driving wheels, coupled | 16 ,, ,, ,, | 6ft. 3in. |
| ,, trailing ,, ,, | 15½ ,, ,, ,, | 6ft. 3in. |
| ,, tender (with coal and water) | 36 ,, ,, ,, | 3ft. 9in. |
| ,, total | 85 tons | |
| Heating surface—Tubes | | 1180 sq. ft. |
| ,, ,, Fire-box | | 120 sq. ft. |
| ,, ,, Total | | 1300 sq. ft. |
| Fire-grate area | | 20¾ sq. ft. |
| Boiler pressure | | 175 lb. per sq. in. |
| Tender contents | | 3000 gals. water, 5 tons coal |
| Automatic vacuum brake. | | |

These engines have been perfectly successful in every way, keeping time in very heavy weather. The chimneys are fitted with a device for inducing an air draught, which also tends to prevent the distribution of sparks. Mr. Jones has found that this gives satisfactory results.

The Corporation of Sheffield propose to construct a new bridge over the river Don, at Ball-street, Sheffield. The bridge will be of arched steel girders on stone piers, and the plans and quantities have been prepared by Mr. Charles F. Wike, M. Inst. C.E., city engineer. The tender of Messrs. Braithwaite and Co., of Leeds, amounting to £9087 15s. 4d., has been accepted.

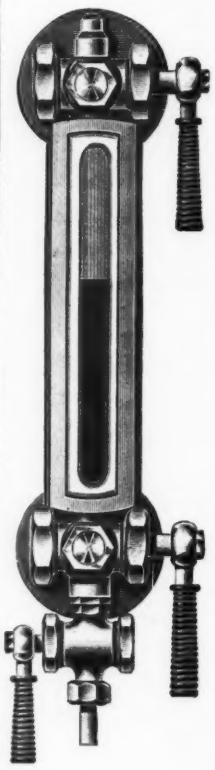
## LAUNCH OF H.M.S. OCEAN.

The Ocean, battleship, was launched at Devonport on the 5th by Princess Louise—Marchioness of Lorne—in the presence of enormous crowds of spectators. Great interest was taken in the event at Devonport and throughout the neighbourhood, and excursion trains were run by the railway companies from various parts of Devon and Cornwall. Twenty-five thousand persons are officially estimated to have entered the dockyard.

The naming ceremony was successfully performed by the Princess, and she was then presented by Rear-Admiral Carr with a mallet and chisel enclosed in a handsomely carved box which had been made in the dockyard. Then came a weary and anxious period of waiting. According to the programme the launch should have taken place at 5.30, but it was not effected until twenty minutes past six. The delay was due to the fact that earlier in the day the vessel had begun to slide down. It was found at two o'clock that she had moved ½in., and it was then decided to replace the blocks which had been removed in readiness for the launch. The ship then settled down upon the blocks, and when the time came for launching her it was found necessary to split them up. Owing to the rising tide two or three blocks became submerged and could not be removed, and the Ocean cut these up as she passed over them into the water. The cord holding the weights by which the dogshores were to be knocked away was severed by Princess Louise at twenty minutes past six, just as the tide was at its height, and the vessel at once slid gracefully into the water amid the cheers of the thousands of spectators.

## THE REFLEX WATER GAUGE.

A water gauge is being introduced by Messrs. Richard Klinger and Co., engineers, 66, Fenchurch-street, London, which deserves the attention of steam users. Instead of the ordinary glass tube, the Reflex gauge employs a strip of plate glass, from ⅛in. to ⅜in. thick, secured in a gun-metal casing. This glass is shaped on the back prismatically, so that it will reflect the rays of light in the steam space only, showing a sharp and well-defined line where the water terminates. At a distance of 30 yards it is stated that the attendant can easily see the height of the column of water. The makers claim that, owing to their special method of mounting and the high quality and extreme thickness of the glass employed, breakages, due either to external causes or caused by expansion and contraction, are reduced to a minimum. We understand that the Admiralty authorities are giving the Reflex gauge an extensive trial.



New U.S. Battleships.—Three new battleships, for which bids are soon to be called for by the United States Navy Department, are to have the following dimensions:—Length, 368ft.; breadth, 72ft.; mean draught, 23½ft.; displacement, 11,500 tons; coal capacity, loose storage, 1200 tons. The side armour is to have a maximum thickness of not less than 16½in., and an average breadth of 7ft. 6in., extending from the stem to the after barbette, and tapering from the maximum thickness over the engine and boiler spaces to a uniform thickness of 4in. forward. The barbettes for the 13in. guns are to have walls 15in. thick, except in the rear, where they may be reduced to 10in. The turret armour will be 14in. thick. The sides from the armour plate to the main deck will be protected by not less than 5½in. of steel armour, and the protective deck is to be 2½in. thick on its flat surface, and from 3in. to 5in. on its slope. The power will be supplied by two vertical triple-expansion four-cylinder engines, driving twin screws. The batteries will consist of four 13in. guns in barbette turrets, ten 6in. rapid-fire guns in broadside on the main deck, and four on the upper deck, and a secondary battery of twenty-four smaller rapid-fire and machine guns. There will be two submerged torpedo tubes. The vessels will be accepted from their contractors if their speeds are 16 knots or more, says the *Engineering News*, but for speeds of less than 16 knots penalties will be assessed of 25,000 dols. per quarter-knot deficiency from 16 to 15½ knots, and 50,000 dols. per quarter-knot deficiency under 15½ knots.

Manila Hemp, which every engineer uses, but knows little else about, is the product of a species of banana—*Musa textilis*—and is cultivated in certain localities in the Philippine Islands. The plant, called "abaca" by the natives, throws up a cluster of sheathing leaf stalks to a height of 20ft. or 30ft., which spread out at the top into a crown of huge, undivided leaves. It is cut down when three years old, and the sheathing stalks are torn apart and reduced into strips. These strips, when fresh, are drawn between a knife and a wooden block, until, by continued scraping by the expert natives, the soft, cellular matter is removed, and the fibre is then hung up to dry in the open air until it is ready for use. Each stalk yields about 1 lb. of fibre, and two natives, cutting down and scraping, will produce only 25 lb. per day. The fibre of the outer layer is hard and strong; that from the inside is fine, thin, and weak, and is used by the natives in making articles of dress. The whole supply of Manila hemp practically comes from the Philippines, and the United States consume 41 per cent. of the export, says the *Engineering News*. In 1897, out of 825,028 bales exported, the United States took 417,473 bales; Great Britain imported 385,182, and the Continent of Europe, 22,373 bales. It is the most valuable of all fibre for cordage, as it possesses great durability and strain-resisting power. Manila rope is now frequently adulterated by an admixture of New Zealand flax and Russian hemp.

Trade and Business Announcement.—Messrs. George Cohen, Sons, and Co., new and old iron merchants, Commercial-road, E., on June 30th, took Mr. Lawrence Levy as a partner, the style of the firm remaining as before.

## THE WEAR OF CHAINS.

By R. WEATHERBURN, M.I.M.E.

THE few accidents that occur to life and limb by the breakage of chains would tend to the belief that the quality of material from which they were made was exceptionally good, with frequent and capable examinations, or that a very generous margin of strength was allowed. The fact is that a far greater number of breakages take place than is ever known, but, in the vast majority of cases, are fortunately attended with no more serious result than damage to material and the inconvenience of delay, hence the complacency in which the indiscriminate and too often reckless use of chains is viewed.

The general application by land and sea, in workshops, factories, warehouses, shops, &c., must necessarily include a considerable proportion which never receive the benefit of periodical inspection. Nor is it to be supposed that a merchant or warehouseman should possess the knowledge, or have the time and desire, even if competent, to inspect such matters. It is generally sufficient for him to have repaired with the utmost despatch, or renew one which has caused trouble and delay by breakage. Even in the larger industries, where the services of engineers are more frequently requisitioned, the chains only receive desultory attention. It is only too true that the accidents that do occur are mainly the result of the margin of safe wear being exceeded, and that the tardy attention given is due to such unpleasant rotifications.

Nearly every class of machinery is open to Government inspection or control, but the chain of the builders' steam derrick or crane, high aloft, often over the heads of the passers-by underneath, conveying bricks from front to rear, or the long chain depending from the upper storey of the warehouse, with its ascending or descending loads, seems to be left to the supervision of Providence alone.

It is not intended to suggest a remedy for this state of things, but simply to bring under notice the wear attending the use of chains, and point out the cause for such.

There are two kinds of wear, which, for the want of a better title, we will designate as determinate and indeterminate, or visible and invisible, and both are the result of motion with weight. Both wears are contemporaneous, but not equal. The determinate wear is principally confined to certain localities or parts only, and can be looked for with certainty as being the results of simple or complex movements, which more or less alter the shape and size of links by abrasion, distortion, or weight, and can only be effectually dealt with by removal and substitution.

Indeterminate wear is unseen, and is the result of weight and movement, acting and reacting on the organic structure in such a manner as to produce a slow but sure change from the fibrous—which should be the normal condition—to the molecular or crystalline condition. The phases of these alterations are irregular in proportion to the irregularity of the stresses passing through, and the portions or sections of chain acted upon. This physical and chemical change is assisted by changes of temperature. Indeterminate wear can be dealt with by periodical annealing.

Determinate wear is always greatest in ill-designed machines *per se*. Acute knuckling motion of links passing round pulleys of too small diameter readily suggest the importance of larger diameter pulleys; indeed, it should be an axiom of crane makers to lead the chain from one straight line to another by as large a radius as practicable, so as to reduce articulation of links as much as possible. Pulleys with too large a hollowed race or channel for the chain are responsible for a canting or rolling motion, which causes twists to form and rapid local wear. This, too, suggests the expediency or wisdom of using the grooved-shaped pulley whenever possible. At all events, it may be understood that the greater the number of pulleys the greater the wear. These items, important in themselves, are simply proofs that wear is often produced, not so much by work done, as the variation in the position or the links when doing it. Twisted chains, *i.e.*, chains defectively made with a twist, as also others which have become twisted by mismanagement, evidence determinate wear with great rapidity, and so localised as to render it very dangerous. At times a badly-twisted chain, say from ¼in. to ½in. twist, will, in spite of the best lubrication and management, reduce the lifetime by one-half. The shorter the twist the greater the local wear, and *vice versâ*. It is the righting of the twisted portion under weight which causes the mischief, for with the most effective oiling the chain may be not one iota the worse in the straight parts, and be worn dangerously at the twisted portion.

There is another wear not produced by actual work, but by the return of the unloaded chain for the next lift, rubbing against surfaces, and caused by the want of proper guide pulleys. This wear affects the sides of links only, but is none the less very serious—see Fig. 1. The wear of chains is materially affected by their construction. This should be the better understood, seeing that every link represents a weld, the soundness of which can only be proved by absolute wear. The guarantee tests are certainly very valuable, but not to the extent generally supposed. Chains which have been guaranteed and certified as tested, have under normal loads been known to seperate at welds, disclosing superficial welds, *i.e.*, only the outer edges of scarfing having been united, and the middle black—see Fig. 2. Fortunately it is a very rare occurrence for a chain to break at the sides of links. The ends not only exhibit the principal wear, but furnish over 90 per cent. of the fractures. Now, assuming the material to be only moderate, and the workmanship the same, it is easy to see that the results are in proportion. The bending of the links to the right curvature at the ends with such material, and with an imperfect heat, would be sufficient to impair permanently the fibre at the outside or point of greatest distension, but really in all cases of sharp bends, the damage is greater on the inside where the crushing together crowds the fibre out of shape, or in other words, dislocates them, and it must not be forgotten that it is at these points that the most punishing strains are applied. The welding may be all that can be desired, and the wonder is that so few are bad, but there are peculiarities in the socket wear of chains, not breakages, which suggest that the same hand has not been equally sure. The rapid wear at one link of a chain, or at one end of a link—see Fig. 3—working under precisely similar conditions to the other, can have but one solution, viz., the link in question by more or less hammering at doubtful temperatures, has become softer, or spongy.

FIG. 1.

Showing wear at sides of links

FIG. 2.

Showing bad weld

FIG. 3.

Link worn at one end only

Wear to breakage is largely due to socketing—see Fig. 4—but in proof of isolated wear it is occasionally found that one link only of the two so engaged is badly socketed—see Fig. 5—but as this rarely occurs, socketing is fairly represented by equal wear, not of all links, but of the two links engaged. Before ever the stage of attenuation has been arrived at as shown, a disintegrating force has also been at work, and it is simply due to the margin allowed that the chain has not come to grief. Socketing is very largely due to want of lubrication, and to extra movement at that part or link, and it may safely be claimed that such extraordinary local wear is often the result of a combination of evils.

Defective welds are of two kinds, viz., those where scale or dirt intervenes, and prevents a portion of the surfaces coming into contact, and others by a deficiency of temperature, causing only partial union, and not a true welding of the two surfaces. The former are the most difficult to detect, as the process of hammering out the scarfs, as a rule, leaves the surface a little hollow, causing the edges of the scarfs to unite, and imprisoning the dirt or scale in the hollow formed by the convex face of hammer. The writer has known such defective welds to defy the closest examination by glasses, and in one instance where the chain—a very heavy one—had been certified as duly tested, and guaranteed, it broke at a much lighter weight than that for which it was specified, and no wonder, for the weld was so very partial as to comprise but a fraction of the area of the weld, representing a complete ring, but in width less than $\frac{1}{32}$in. all round, enclosing a black area of hammer marks. The latter welds, viz., those attempted at imperfect temperatures, are, in spite of the means adopted to hide them by hammering, as a rule, observable, owing to the edges not uniting. This view must not be taken as arbitrary, for the edges of the scarfs cool down quicker than the body, and sound welds often display suspicious edges.

FIG. 4.

Links socketed

Indeterminate wear is not general throughout the length of chain, but is even more localised than outside wear, being subject, not only to the same influences which produce outer wear, viz., weight and motion, but also to differences of temperature and vibrations, shocks, &c., which mostly affect those portions of chain which receive the most movement. For example, the portions most affected are those nearest the quick-running pulleys, and the least affected are those which are on drums or slow-moving pulleys. The influence of cold on the cohesion of chains is very remarkable, and should be taken seriously into account in cold weather or in cold countries. Fortunately, in spite of the insidious and dangerous character of the unseen wear, it can be dealt with much easier and more generally than determinate wear. The process of annealing, or in other words, restoration, is so easy as to come within the range of every user of chain, although the easiness of the process may cause it to be carelessly done. Annealing can be accomplished in a furnace, but the temperature should never be more than that represented by what is known as red; any higher visual temperature may produce scaling, which would be loss.

FIG. 5.

One link only worn

The chain during annealing should remain at the red heat for at least two hours, and when removed be put to cool gradually in a sand or ash bath. When a furnace is not available, an improvised grid, composed of iron bars, each bar from 1in. to 2in. apart, with the ends resting on brick supporting walls from 2ft. to 3ft. high, can be built in the open, and the chain laid thereon, coiled in such a manner as to become pervious to the heat, built both under the grate and above, with wood faggots, maintaining the fire until the proper heat has been obtained. The result will be satisfactory.

For the making of chains, the shape and length of links are points of great importance. Long links when used on pulleys of small diameter undergo more motion—knuckling action—and consequently more wear than the short ones, besides taking up more strains. On the other hand, it is equally certain that a chain composed of longer links has a less number of welds than one of equal length composed of shorter links, and consequently less liability of defective welds. Therefore, the length of links should be carefully proportioned to give the minimum of articulation without unduly increasing their number or rendering them too short for sound welding. Chains in use always become longer, not alone in consequence of wear at points of touch, but also due to elongation or lengthening of links, produced by sudden strains and heavy work. A chain when properly proportioned for a certain weight should practically recover itself after such elongation, and no better proof is required that the elastic limit of the chain has not been overstepped. Wherever serious permanent elongation of such a chain has taken place, it may be safely assumed that it has been subjected to rough usage, or that the proper weight has been largely exceeded. These points lead us to the question of what constitutes a properly shaped link to give the needful recovery after proper use. Now a chain which has received violent treatment beyond the elastic limits is always narrower and longer in the link than previously, and one of the peculiar evidences of such treatment, and particularly noticeable in light chains with long links, is the indrawn sides of the links, which in severe cases become narrower than the diameter of the iron, and hold each other in a vice-like grasp—Fig. 6—and the chain is practically inarticulate and no longer workable, but when this occurs, it proves conclusively that the material is at least good. The indrawing is merely the disposition of the sides of links to follow in the line of forces which pass through the other engaging links. Such goes to prove that the sides of links should never be parallel unless unavoidably required, and each side should form an easy radius.

FIG. 6

Showing links indrawn

The lubrication of chains, although long practised by many, is not the unqualified benefit supposed. In some instances this want of success is due to the system pursued, and in others to the lubricant used, but mainly both system and lubricant are faulty. The application of lubricant to a chain at full stretch—in position—is at best a very imperfect one, as the points of contact of the links are so small that but a slight weight precludes the ingress of the oil. Again, oils or grease with good viscosity lack the fluidity necessary to get to the points named, and if rendered fluid enough to do so, no longer possess the needful viscosity to benefit, and is easily excluded with light weights.

Should the chain be well worn, *i.e.*, socketed at the linking points, the surfaces become so close as to prevent ingress. Effective constant lubrication can never be obtained, as all sudden accessions of weight on such small areas of touch are sufficient to destroy the oil film, and cause metallic contact and abrasion, so that partial lubrication under the most favourable circumstances is only obtainable, and that too by adopting the best plan, viz., periodically lowering the chain into a barrel of grease or oil of the proper consistency and viscosity to enable the unguent to have access to every part.

A limited elasticity is one of the needful requisites of a good chain. Without elasticity it becomes little better than a solid bar under weight, therefore the form of the link has much to do with the longevity of the chain. If the links be too long and too much of the oval the elasticity, providing the chain be duly proportioned, would be too great and beyond recovery; but with medium size links of the semi-oval pattern, the elasticity would be such as to take off the severe shocks consequent upon quick lifting without seriously impairing their form.

The stresses to which chains are subjected as a rule come very irregularly, and it will be readily understood that they are exactly in proportion to the load in the case of a band crane with slow movement and direct lifting without lurch or click, but with steam or hydraulic cranes, running at a speed much beyond that of hand lifting, it is impossible to estimate them by the weight lifted. Every lurch in the weight, every little click or adjustment of the chain, either in the pulleys or drum, causes a slight increase of weight. The lifting or stopping with speed has its immediate action on the chain, and it is amusing how the needle of the dynamic register, when used, is incessant in its movements during the quick lifting or lowering of moderately heavy weights, so that the normal elasticity of a chain stands as a reservoir of absorption to diminish these acute differences. A powerful brake mounted on an axle, so stubborn as not to show the slightest tendency to torsion, is one of the most effective agencies for the destruction of chains. A sudden application of a brake of this character does more harm to the internal and external wear than almost anything else, and it is only the native elasticity of the well-proportioned and made link that can for any length of time stand against this trying ordeal.

Chains with small links are subject to much more friction than chains of medium-sized links, although made from the same iron as the long links; such chains are by necessity stubborn, and although apparently equally as strong are really more liable to break, owing to the greater difficulty of making sound welds; in short, links of strong material.

The molecular change or transition from the fibrous to the granular form, though it be slow or quick, is but a constant wear in proportion to the amount of work done and influence of the surroundings, and as the change progresses it only becomes a question of time to reduce the normal cohesion to such an extent as to render the chain no longer able to perform the work without breakage. Literally failing by exhaustion, therefore it must be considered as wear. This internal wear is always the more rapid where the conditions of irregular weight and working exist. An ill-adapted chain, where the links are not proportioned to the pulleys or barrel diameter, or badly-shaped pulleys on which the chain never secures a proper seat, noisy and clicky in work, are always very unfavourable to longevity, particularly where the chains are also subject to excessive cold or sudden great changes of temperature. The more silently a chain works the better.

## LOCAL AUTHORITIES AND THE WORKMEN'S COMPENSATION ACT.

THE uncertainty that surrounds the actual financial liability of employers under the Workmen's Compensation Act has induced the Vestry of St. Margaret and St. John, Westminster, to convene a conference of all the local authorities thoughout London, to consider the desirability of such authorities in combination forming an assurance fund, with respect to claims which may be made by their workmen. Pending the selection of a day for the holding of the conference, it is noteworthy that one authority—the Islington Vestry—has received and adopted a report of its Parliamentary Committee setting forth the extent to which it is believed the vestry is liable under the Act.

The report points out that the vestry will be liable to pay compensation for accidents in accordance with the scale and conditions set out in the first schedule to the Act, to persons engaged in or in connection with steam laundries; to any workman engaged in the construction, alteration, or repair of sewers; or in the construction, alteration, and repair of roads, where machinery driven by steam or other mechanical power is used; and to the employés at the vestry's electric lighting station, notwithstanding that, as Mr. W. F. Dewey, vestry clerk, has pointed out, it does not appear from the reading of the Act, and the Acts incorporated therewith, that it affects the employés at the electric light works. With a view to obtain information on the subject of the risk, quotations were obtained from insurance companies showing the rates of premium required to be paid to insure against the liability under the Act. The following rates were elicited:—

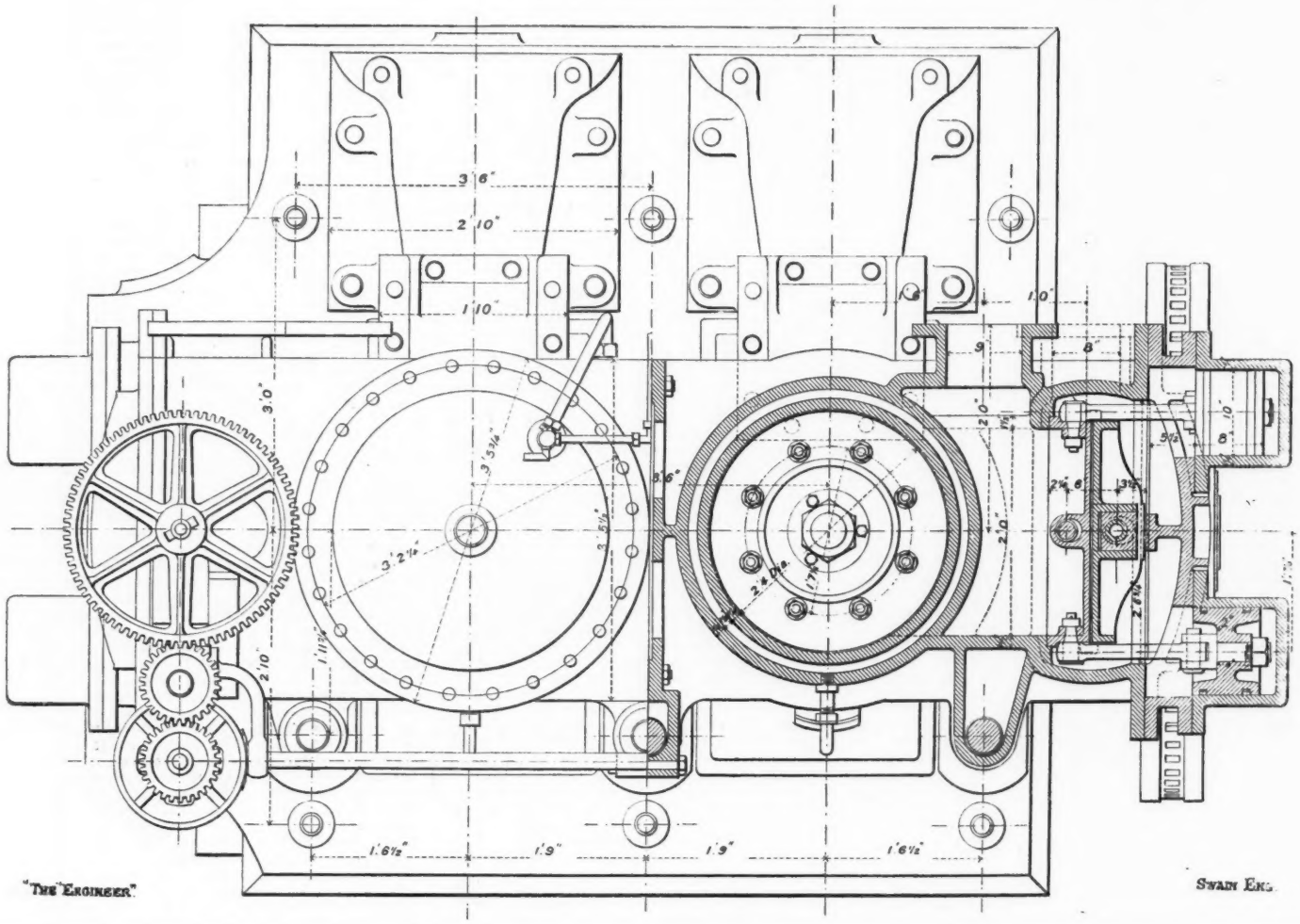
| | Rates per annum. |
|---|---|
| Accident Insurance Company .. .. .. | 17s. 6d. per £100 wages |
| Employers' Liability Assurance Corporation .. .. .. .. .. .. .. .. | 17s. 6d. ,, ,, |
| Ditto, electricity works employés only | 50s. ,, ,, |

The 17s. 6d. quoted by the second company only covers the whole of the vestry's employés, with an aggregate wage of about £50,000 per annum, whilst the 50s. premium is subject to discounts when the wages exceed £10,000 per annum. In addition to these, the Ocean Accident Corporation and the Sun office offered to submit quotations on a proposal being forwarded on one of their official forms.

It may be mentioned that the London County Council does not intend to take any action until it is shown how cases are decided under the Act; and the Islington Vestry has resolved, in view of the above-mentioned high rates of premium, to follow the example of the Council, and not to insure until experience has been gained of the working of the Act.

# PUMPING ENGINES, GLASGOW GRAVING DOCKS

(*For description see page 29*)




## WAR NOTES.

CERVERA'S fleet has met the only end that it could possibly expect when it issued from Santiago harbour. The telegraphic reports of the battle are too contradictory, too obviously non-technical, at times even too obviously untrue, for it to serve any purpose to follow them closely. To form any opinion of value on the action, to draw any useful lessons, we must have authoritative information upon the amount and sort of ammunition at Cervera's disposal—the state of his machinery, boilers, and bunkers. This we shall certainly fail to obtain for some days yet; it is doubtful if we ever get exact particulars. It is a matter of merely superficial interest to be told that Cervera fought pluckily, and that the Americans are heroes who have put Trafalgar in the shade. The information at present to hand really amounts to little more. Our present purpose is to examine the ships engaged, to deduce what Cervera might have done had certain conditions been fulfilled. It is obvious that some, if not all, of these are wanting. When details of these can be learnt, it will be possible to arrive at some idea of the lesson, if any, to be gathered from Cervera's destruction.

To review briefly the battle itself, selecting such of the telegraphed incidents as are not obviously incorrect, we gather that about 9.30 a.m. last Sunday morning Cervera's fleet issued from Santiago harbour, the Cristobal Colon leading, the Vizcaya, Oquendo, and Infanta Maria Theresa following astern, the fleet being in single line ahead, the only formation possible, we should imagine. The two Clydebank destroyers Furor and Pluton independently attacked at the same time and place, and were at once sunk. The American fleet consisted of the battleships Iowa, Indiana, Oregon, Texas, and the armoured cruisers Brooklyn and New York. Eight miles from Morro Castle the Oquendo and Maria Theresa were driven aground and destroyed. Assuming their speed at 15 knots, the maximum duration of these ships was therefore a trifle over half an hour. The Vizcaya was destroyed two miles further on, say, ten minutes later. The Colon, if accounts are true, held out for over 20 miles—we may say that she, perhaps, endured for an hour and a-quarter.

Assuming no misses, and the use of the right projectile, the time required to put the Colon out of action, presuming her to have been attacked by the New York and Brooklyn as reported, would be half a minute, the 8in. guns with armour-piercing shot alone being used. If, then, the Americans fired continually at full rates their percentage of effective hits is only ½ per cent. Since, however, their supply of solid shot could hardly allow of more than fifteen minutes' continuous fire at theoretical rates, their minimum accuracy would be from 2 to 3 per cent.—for vital hits a moderately high one. This is assuming one shot to disable each barbette, three to disable the battery. There is nothing to suggest the "excellent shooting" that is claimed, and if Captain Orde-Brown is right in his contention in the 1898 "Brassey," that the "excitement of action" should influence shooting comparatively little, then American gunnery is not unique. However, discussion of these matters is best left awhile.

Returning to the ships, the Vizcaya type might be put out of action, theoretically, by one big or two or three 6in. common shells under each barbette; one big shell or a few 6in. would settle their unprotected 6in. guns. Shot alone could get through their belts, and it is unlikely that their speed would have been affected save by damage to uptakes.

Given a good admiral, good gunners, and plenty of ammunition, the American battleships are in little better condition. The Spanish fleet mounted six 11in. guns that at 2000 yards might with armour-piercing shot silence the big guns of the Iowa, Texas, Oregon, and Indiana. But the ends of all these ships were open to shell attack from small guns, while 6in. shot could get under the turret bases of all save the Texas. The Iowa, indeed, has her fore turret in exactly the same predicament as the Vizcayas—it is open to all shell attack. Theoretically, all these ships could have been capsized by determined shell attack on their ends, with shot attack later when their submersion was increased, for then the water-line would be protected, not by the 18in. Harvey belt, but by the 5in. armour of the lower deck. Had Cervera had good gunners and plenty of ammunition he should have been able to get away.

The Cristobal Colon claims the most attention. This ship is, if statistics be true, practically coated with 6in. Harvey armour, proof against anything less than a 6in. shot, even at 2000 yards. She had a good speed—an excellent one on trial. It should have been possible for her to attack with ram or torpedo. It is almost impossible to conceive how the 8in. guns of the Brooklyn and New York can have disabled her by shell attack as reported, since in theory nothing less than a 12in. armour-piercing shell can get through 6in. Harvey. The question is—Have Harvey plates failed to support proving ground experiments? A report on the condition of the Colon when captured will excite intense interest in service circles. There are some who have claimed that continual attack from small guns will destroy Harvey plates that would totally defeat individual attack from such guns; if this should prove to be true, what will be the value of our Majestics, or, for that matter, of most modern ironclads? Perhaps it is early to ask this question, but it is one that must be uppermost during the next few days.

It is idle to inquire how Cervera's guns did so little harm. Probably later reports will show the damage sustained by the Americans greater than at present. From the purely scientific standpoint it is a matter of regret that one of the American "soft enders" was not badly wrecked in the bow, so that we might solve the vexed question of unarmoured ends—the question is a vital one with us.

Roughly, the Vizcayas embodied the French system of protection; their belts were nearly complete. The Shikeshima, building at Blackwall, and the French Jémappes class are the only battleships with complete belts and armoured turret bases like the Colon. They have, of course, thicker armour, and not the Colon's thin shields to the big guns. The Americans were all "soft enders" like our ships, but devoid of our heavily-armoured turret bases.

The fight seems to have been too one-sided to be likely to produce definite results that can be applied to our ships as regards armour. There is, however, another result of equal importance. Except the Texas, all the Americans, and of the Spaniard, the Cristobal Colon, were armed on what may be termed Elswick lines. They are all heavily-gunned ships. If this heavy gunning has led to no ill-results, no straining of the ships, no trouble in feeding the guns, then Mr. Watts, of Elswick, is right. Which is best, excessive gun power or excessive stability? The Vizcayas were the only medium-armed ships. If the battle of Santiago throws light upon this question, a very vexed and intricate problem will be in way of being solved.

## MANGANESE FROM BOG ORE.

BOG iron ore is worked in the province of Quebec, Canada and arrangements are now being made to extract manganese from bog ore deposits in the province of New Brunswick by the Mineral Products Company. The ore is a soft, wet stuff, containing 50 per cent. of water, and is covered by a thin coating of vegetable earth. The depth of ore varies from 5ft. to 30ft. When dried the residuum is a fine black powder, too fine to be treated in the blast furnace, and this has therefore to be made into briquettes, as is done with the fine dust from blast furnaces and the finely-divided iron produced from low-grade ores by the Edison electrical process. The cementing material used is kept secret. The ore is brought in small tram cars into the building and shovelled into the feed hopper of a drier, which is an inclined iron cylinder 5ft. diameter and 28ft. long, revolving slowly in a brick chamber or furnace 44ft. long, 10ft. wide, and 30ft. high. The dried ore falls from the end of the cylinder into the trough of a spiral conveyor, and is carried to a vertical bucket conveyor, which hoists it to the top of the building and feeds it into a revolving screen. The coarser material passes out at the end of the screen and goes to a pulveriser, from which it is led back to the vertical conveyor. The very fine material which passes off as dust is caught by a dust chamber and also carried to the vertical conveyor.

The screened ore dust is stored in bins and fed to a mixing machine, where it is mixed with some "binder," which forms it into a plastic material, which is taken to the briquette-pressing machine, from which it is delivered in the from of cylindrical briquettes, 3in. diameter, and 2¼in. long. These are stored away, and at intervals loaded into railway cars and taken to the company's blast furnace in Nova Scotia, where they are converted into ferro-manganese for use by steelworks.

An analysis of the dried ore at 212 deg. Fah. is as follows:—

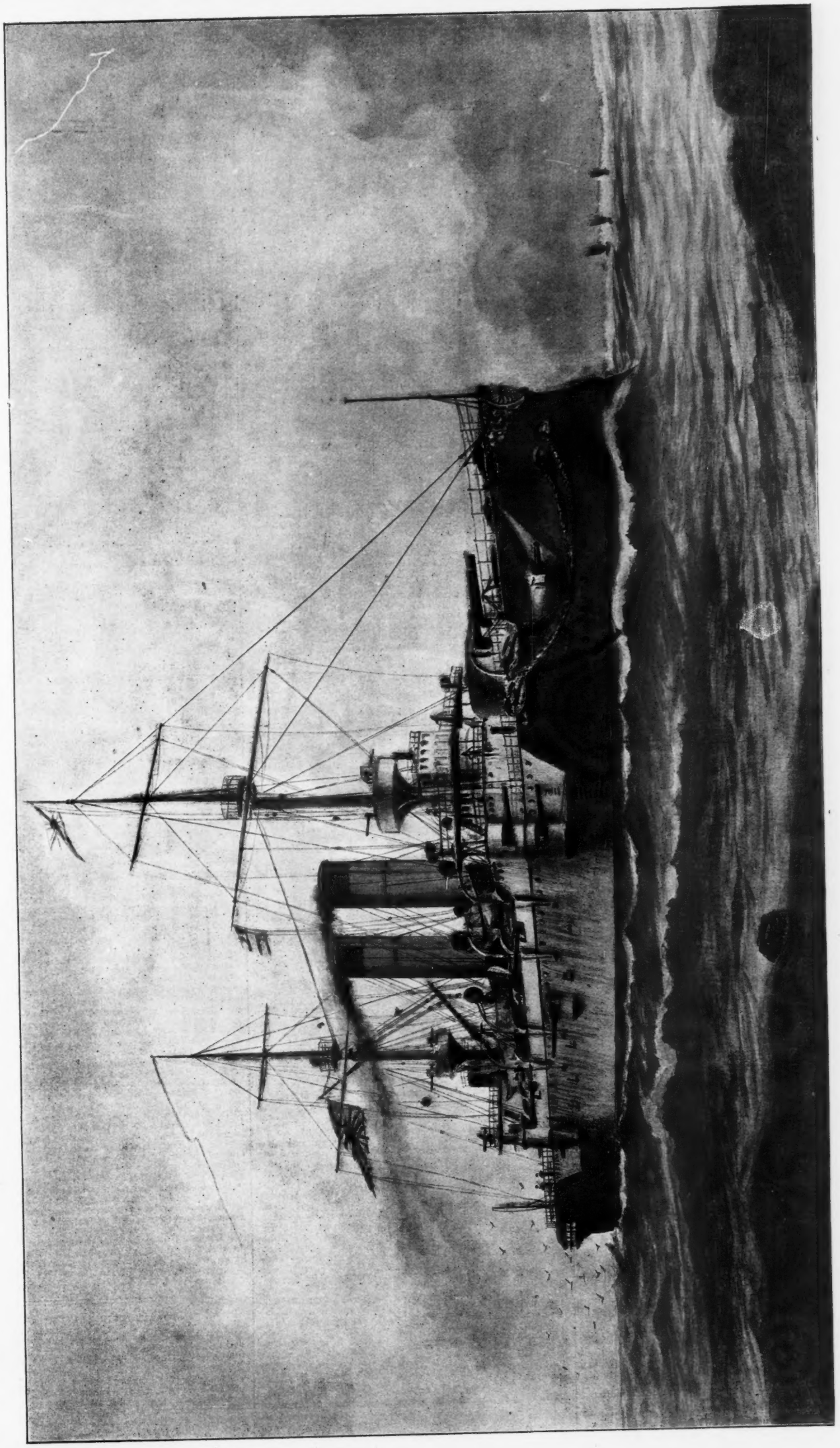
| | |
|---|---|
| Metallic manganese | 48·240 per cent. |
| Metallic iron | 5·700 ,, ,, |
| Sulphur | 0·096 ,, ,, |
| Phosphorus | Trace |
| Silica | 1·88 ,, ,, |

ELECTRICAL ENGINEERS, R.E. (VOLUNTEERS).—It has been decided to enrol no more men for this year. As many men as can be dealt with at the first training—which takes place at the Western Defences, Isle of Wight, in July and August—have now joined the corps. Further applications will, however, be received, and eligible men engaging to enrol may attend a certain number of military drills during September and October, though they cannot be formally enrolled before November 1st, the beginning of the next volunteer year.

# THE JAPANESE PROTECTED CRUISER TOKIWA

MESSRS. SIR W. G. ARMSTRONG, WHITWORTH, AND CO., LIMITED, NEWCASTLE-ON-TYNE, BUILDERS

(For description see page 30)



## LETTERS TO THE EDITOR.

*(We do not hold ourselves responsible for the opinions of our correspondents.)*

### ARGENTAURUM.

Sir,—In your issue of the 10th inst. is an article entitled "Argentaurum," containing various statements with respect to myself. As some of these statements are opposed to the facts of the case, and as I am quite sure that you desire your readers to be correctly informed by what appears in your columns, I assume you will afford space for the following reply.

(1) The article says, "Emmens has supplied a substance he called Argentaurum, and considered a new element. He had not been asked to send gold—'Argentaurum gold'—derived from this new element. It was, according to him, the new element that comes in Mendeléeff's system between silver and gold that he sent. This Crookes' investigation showed to be nothing but an alloy of gold and silver and a little copper. Observe that the source of this substance had nothing whatever to do with the question. It was stated to be a new element, and has been shown to be an old alloy." You must have been very much misinformed when—of course, in perfectly good faith—you penned such a series of inaccuracies. Sir W. Crookes' request was worded as follows:—"Will you oblige me by sending me a small piece of the gold you have made? I have been working for some years on the spectra of the metallic elements, and I have some very good photographs of the spectra of both gold and silver from metals prepared at the mint and absolutely pure. It would be of the highest interest to take partially superposed spectra of yours and my gold and see how the lines agreed." My reply was:—"It is with pleasure that I accede to your request for a piece of 'Argentaurum gold.' The enclosed was cut for you by the officials of the United States Assay-office in this city from an ingot of gold produced by me in the Argentaurum laboratory, and deposited yesterday for examination and purchase by the Government."

(2) The article says, "We may say at once that he, after following Dr. Emmens' instructions, has arrived at absolutely negative results. The admitted facts are that Sir Wm. Crookes tried two experiments, and that the result of the first was thus reported by him:—

| | |
|---|---|
| Hammered Mexican silver taken for assay .. | 100,258 grains. |
| Weight of gold bead .. .. .. .. .. .. | 0·075 grains. |
| Equal to .. .. .. .. .. .. .. | 0·075 per cent. |
| Some of the same silver, before treatment .. | 96,837 grains. |
| Weight of gold bead .. .. .. .. .. .. | 0·060 grains. |
| Equal to .. .. .. .. .. .. .. | 0·062 per cent. |

The difference is 0·013 per cent., which I consider is not enough to enable me to form an opinion on, as it is within the errors of experiment." This was clearly not an "absolutely negative result." The second experiment was not carried out in accordance with my instructions. I had never directed Sir W. Crookes to operate upon abnormal Mexican dollars. Every chemist is aware of the important changes frequently effected by the mere "action of presence" of an element. When, therefore, Sir W. Crookes took pains to select Mexican dollars absolutely free from gold, he was simply taking pains to render his experiment scientifically worthless as a test of anything I had advanced.

(3) The article says, "There is certainly no man living a greater authority on the spectra of the elements than Sir William Crookes. No one will therefore hesitate to accept his assertion that the substance submitted to him was mainly gold, with a little silver and copper present. Emmens, we believe, has used this statement as a testimonial of the genuineness of the transmutation. It is, as Crookes intended it to be, the very reverse." You have been misinformed. I have nowhere "used this statement" as a testimonial of anything. I have, on the contrary, shown it to be incorrect, seeing that it conflicted with the results obtained in the laboratory of the United States Mint at Washington. Moreover, Sir W. Crookes himself has admitted its inaccuracy by admitting the presence in the sample of Ar-gold of elements other than gold, silver, and copper. I will not occupy your space by discussing the purely spectroscopic features of the question, which, I imagine, would be hardly suitable for your columns. I will merely say that a careful examination of the photographs taken by Sir W. Crookes proves the presence in Ar-gold of something which, while neither gold nor silver, possesses some of the spectroscopic features of both these elements. This will be clearly shown in a forthcoming issue of *Research*, the journal of the Research Society.

(4) The article says, with reference to me, "His position as a scientist will, in the eyes of Englishmen at any rate, suffer considerably from the manner in which he has used a private correspondence to advertise the Argentaurum Syndicate, and from the manner in general in which he is bringing that concern before the eyes of the public." Here again you have been misinformed. I have nowhere "advertised" the Argentaurum Syndicate. That institution does not need any advertisement. It has no dealings with the public; and in order to prevent any possible misapprehension I took care some months ago to openly state in one of your English newspapers—the *Daily Chronicle*, of December 31st, 189,—that no opportunity would ever be afforded to any outsiders of becoming connected with my gold-producing business. In this matter it is permissible for me to say that I suffice for myself. But when it comes to a question of the public advancement of knowledge, I must plead guilty to the charge of appealing to the world at large. Nay, more, I am positively contumacious. The fate of Benjamin Franklin does not terrify me. His "position as a scientist" suffered more than considerably "in the eyes of Englishmen." He was for a long time flouted and jeered at by Fellows of the Royal Society; but full amends were finally made in a very handsome manner.

(5) Pray, however, allow me to say that I do *not* appeal to the world at large on the question of Argentaurum. From the very outset I gave public warning that I did not offer this matter for any scientific consideration whatever, that "no disciples were desired," and that "no believers were asked for." But what I did put forward were certain discoveries and facts relating to migrant matter, celestial mechanics, the laws of gravity, the correlation of the chemical elements—apart from Argentaurum—geological phenomena, radiant energy, &c., which seemed to me calculated to beneficially influence the progress of scientific inquiry into the truths of nature. I propose to continue putting forward these matters. They have already found firm footing in many a scientific circle, and are gradually being supported by the work of, *inter alia*, English leaders of science, such as, for example, Dr. W. J. Russell, V.P.R.S., and Professor J. Dewar, F.R.S. Stephen H. Emmens.

Argentaurum Laboratory,
20, Central-avenue, New Brighton, Staten Island,
New York, June 21st.

### BALANCING STEAM ENGINES.

Sir,—I see that in Mr. J. Whitcher's letter, appearing in your issue of July 1st, he says that he "understands the principle" of my balanced engine "comprises two counter-weighted crank discs rotated in opposite directions by two connecting-rods from the same crosshead." Although by no means new, and not, in my opinion, solving the problem, this idea has in it considerable ingenuity. It has, however, no resemblance, even the most distant, to anything I myself ever designed; and in this instance Mr. Whitcher's information is the pure product of imagination.

In the same letter he writes, "Professor Smith speaks of absorption of energy by the friction of the mechanism, and how it spoils the practical application of the law of equal action and reaction." This statement, if not the product of imagination, must be due to erroneous eyesight, because I am sure that never, since I was a child, have I been guilty of so extravagantly incorrect talk. I spoke of "absorption of energy," certainly; but the rest of the above sentence is wholly Mr. Whitcher's own addition, and it forms not only an entirely erroneous, but also a very palpably far-fetched misinterpretation of my language. I think my language was simple and clear enough for everyone to correctly understand, and as I know that Mr. Whitcher has no object to serve by, and no desire for, misquotation, all that seems necessary is to suggest that he should read again more carefully, if he wishes to criticise usefully. Robert R. Smith.

51, Victoria-street, Westminster, July 4th.

Sir,—Mr. Whitcher has either fallen into an error, or has written that which may very easily be regarded as one. He makes the effect of inertia and momentum depend on the number of revolutions of the crank shaft, but as a matter of fact the stresses have nothing whatever to do directly with the number of revolutions. They depend directly for their amount on the angular velocity of the crank pin, and may be expressed by the following equation:—$C = \frac{w^2 r^2}{0{\cdot}8165}$. Where C is the centrifugal force, $r$ the radius of gyration, and $v$ the velocity in feet per second.

Of course, other things being equal, $v$ depends on the number of revolutions per minute. Mr. Whitcher may very easily be understood to have overlooked the true relation.

He has quite mistaken my contention, which is, that a great deal of blame is attached to engines which they do not deserve, as, for example, in the case I have stated, where a loose belt was the cause of the mischief. I may also add that charges of vibration are constantly brought against engines which are quite unwaranted by the facts.

Mr. Whitcher seems to have forgotten the part played by "tune" in the case of steam vessels. Why should not the same effect be produced on land?

As to the engine which he attributes to Professor Smith, I can hardly imagine that gentleman patenting an engine which has been in use for, I think, about twenty years, driving a well-known rotary blower. X.

July 5th.

### TRANSMISSION OF HEAT FROM HOT GASES TO WATER.

Sir,—I have read the report of the remarks of Professor Watkinson on my paper on the above subject in your last week's issue. Professor Watkinson and myself are very good friends, and after the papers were read he said he trusted that his remarks had not hurt me, but he always said what he felt. It may amuse Professor Watkinson to read that I always like to say and write what I know, and only that; and that it was in consequence of his remarks on Mr. Rowan's paper read at the beginning of this session of the Institution of Engineers and Shipbuilders in Scotland that my paper was written. When the transmission of heat was discussed in that paper there were hardly two points on which two members jointly agreed, and Professor Watkinson was in error in several particulars.

Professor Watkinson unconsciously paid me a compliment at Sheffield. He said I only told them what everyone knew before. I was very proud to think that I had been so convincing. There were no differences of opinion on what I had said after I had done, and a reason had been given for the transmission of heat being at a rate as the square of the difference of temperature which had never been given before, and I do not think it will be upset.

July 5th. Geo. Halliday.

### THE SPEED OF WARSHIPS.

Sir,—In your issue of the 1st inst. I find, under the heading "Dockyard Notes," some comments upon French shipbuilding; among the rest, it is said "French ships have somehow a knack of losing speed at sea." In perusing your article upon the trials of the Terrible, it looks as if this peculiarity was not confined to French ships alone. You are further sceptical as to the Marshal Deodoro, and compare this ship to the Harold Haarfager. It will be interesting to push this comparison a little further. The French ship has a displacement of 3162 tons, and a speed of 15 knots, with 3400 indicated horse-power. The Norwegian ship, you say, has 400 tons more displacement, say 3562, and 300 more horse-power, say 3700. Her trial speed is said to be 17·2 knots. Please note that the French ship has an Admiralty coefficient of 213, the Elswick ship 321. You will perhaps allow me to quote the words of the article in question, and say, "But the figures as given cannot be accepted without reservation." Foreigner.

### THEORETICAL DYNAMICS.

Sir,—I regret that my reply to "Secutor" was too brief for him to understand. With your permission I will give it in greater detail. The falling body "continues to move at the rate of 32·2ft. per second for an indefinite period," that is, moves with uniform velocity; so the forces acting on it must be in equilibrium or balanced. Only two forces act on it:—(1) The attraction of the earth, or its weight, 10 lb.; (2) the pull of the cord. To balance, these must be equal and act along the same straight line in opposite directions. Hence, as I stated, the pull of the cord equals the weight of the body, 10 lb. If the pull of the cord was less than 10 lb., the rate of moving would increase; if greater than 10 lb. the rate would diminish. Both are excluded by the condition, "continue to move at the same rate." Similarly it may be shown that the counterweight must be 10 lb. I trust this will enable "Secutor" to understand how there can be a pull of 10 lb. on a cord uniting two bodies which are moving at the same pace. May I remind him that he asked for "the solution of the problem," not "why his experiment failed." E. Lousley.

July 6th.

Naval Engineer Appointments.—The following appointments have been made at the Admiralty:—Chief Engineers: Henry C. W. Peel, to the Sphinx, and David Peacock, to the Vivid, additional, for the Sheldrake. Engineers: James R. Roffey, to the Victory, additional for gunboats at Haslar, and Percy D. Martell, to the Victory, for the Fawn. Assistant Engineers: Louis R. Croisdale, to the Royal Sovereign; William P. Sillince, to the Rodney; J. J. Kirwin, to the Galatea; Arthur E. Hyne, to the Severn; John S. Hare, to the Colossus; and Charles J. M. Wallace, to the Benbow. Probationary Assistant Engineers: Walter R. Parnall, to the Rodney; Harry J. Wickham, to the Galatea; Alfred J. White and Lionel M. Hobbs, to the Australia; Arthur C. Hall and Henry W. Grant, to the Alexandra; William H. Rosevere and Walter S. Read, to the Colossus; Charles de F. Messervy, to the Benbow; Arthur E. Ewart, to the Melampus; Thomas G. Proctor and Arthur W. Coleman, to the Collingwood; Alfred E. Cock, to the Howe, for service during summer cruise; J. C. Talbot, P. L. Edmunds, E. C. Bartlett, A. W. McKinlay, Sydney Godolphin Misselbrook, A. L. Picton, H. M. Attwood, A. E. Shillcock, H. E. Wolfe, C. Main, W. C. Longland, F. F. May, J. F. Bell, and D. Black, to the Victory, supernumerary, G. R. Martin, W. H. Mitchell, J. H. C. Hearn, J. B. Nicholson, J. Hughes, T. E. F. Lilburn, P. Pollard, G. W. Woodhouse, J. F. Shaw, F. C. Fisher, J. C. M. Boyle, G. H. White, F. W. Hamblin, B. F. Freeman, and W. Begg, to the Vivid, supernumerary, C. G. Greene, W. H. Mew, R. S. Pearce, T. G. Coomber, A. Evans, J. J. Sargent, R. B. Davies, H. W. Portch, R. G. Jeffery, J. S. Walker, J. H. Harrison, C. H. Johnson, and W. G. G. P. Lumsden, to the Pembroke, supernumerary. Acting Engineer: John Murphy, to the Howe.

## FRENCH AGRICULTURAL MACHINERY.

It is interesting to examine the amount of machinery which is employed in French agriculture at the present time, and to indicate its rapid development, and also to ascertain in what class of machines it is lacking. No precise information is in existence regarding the state of the material at the end of the last century. It is only known that the ploughs were simple and rudimentary, after the Roman style or the Gallic plough with fore-carriage; sowing was performed broadcast, and harvests with the aid of reaping hooks and scythes, according to the part of the country. The material at that time was indeed the simplest and most primitive, being constructed by the cultivator himself, who rarely called in the village blacksmith. The machines of to-day have been improved, modified, and become more general, owing to the influence of the present economical conditions, and have followed the same improvements which have taken place at the same time in all mechanical industries. Calculated at the minimum figure of £2 per cultivated acre, the value of the agricultural material of France would represent a capital of £140 millions, and this figure is probably lower than the real value. In 1882 it was estimated that more than five million people were occupied in agriculture in France, but this does not include shepherds and domestics. The French territory covers an area of 110 million acres, 100 of which constitute the agricultural domain, and is comprised of:—Ploughed land, 52 millions; land devoted to cereal culture, 30 millions; to all kinds of pasture, 19,600,000; and to roots, 4,260,000 acres. The number of horses and mares is 2,100,000; of mules and donkeys more than three years old, 548,000; and of draught oxen and cows, 3,019,000. Motors lend their aid to agriculture in the following proportions:—In 1882 there were 12,900 hydraulic motors and 9500 windmills; these latter machines are met with especially in the Western and Northern Departments—1244 in Vendée, and Pas de Calais 500, and Nord 400—where they are chiefly employed for grinding and crushing corn to order—grist mills, in fact. In 1876 there were as many as 4000 portable steam engines employed in agriculture, while 25 years before there were none. The increase of these engines has therefore followed this progression:—1850, nil; 1876, 4000; 1878, 5300; 1882, 9300; 1887, 13,700, of which about a fifth are the property of threshing machine contractors, and the remainder belong to agriculturists themselves. In 1877 agriculture employed 13,700 steam engines, representing a horse-power of 78,740, or the tenth of the total horse-power of the machinery used in France. The average power of the machines destined to culture is 6-horse power. Thirty-six Departments have each more than 200 steam engines; they are chiefly found in the North, Beauce, and Brie regions, and in the Isère, Cher, Indre, and Seine-Inferieure Departments; and also in the South, where the submersion of vineyards is practised, for instance, in the Departments of Aude, Hérault, Rhône, Gironde, &c. The Department of Seine et Marne counts as many as 451 engines. From 1862 to 1882 the increase in steam engines was 226 per cent. From 1877 to 1887 the number of farms in possession of a steam engine increased by 116 per cent., and the power of the motors by 156 per cent. These figures show the great importance that the steam engine has taken in agriculture, and in the future the petroleum motor will be added. The official statistics give the following figures for the chief agricultural implements in 1892:—Ploughs, 3,716,000; drilling machines, 52,000; horse hoes, 262,000; mowers, 39,000; haymakers and rakes, unknown in 1892, but 27,000 in 1882; reaping machines, 24,000; thrashing machines, some very small, 233,000. In 1882 there was one plough per 16 acres ploughed, or per 32 acres of the total agricultural land; from 1862 to 1882 the relative increase in ploughs was only 1·8 per cent., and it was in accordance with the increase in the area cultivated. The land devoted to cereals is about 30 million acres, which particularly affects drills, thrashing and binding machines. The increase in drills was 171·4 per cent. from 1862 to 1882, and 80 per cent. during the period of 1882 to 1892. That of thrashing machines was 79·7 per cent. from 1862 to 1882, and 50 per cent. from 1882 to 1892. The pasture land, permanent or otherwise, is 19,600,000 acres, which is worked by scythes, mowing machines, and horse rakes. In 1882 there were nearly 20,000 mowers, of which the increase since 1862 was 102·7 per cent. These machines are spread over the regions where the production of hay, &c., constitutes the basis of the varied succession of crops. From 1882 to 1892 they increased by 105 per cent. They number more than 1300 in the Department La Mayenne, 1000 in that of Marne, and 871 in the Seine-Inferieure, whilst 25 Departments in uncultivated and mountainous regions in the centre and South of France have each less than 50 of these machines. In 1882 there were 27,000 reaping machines and horse rakes, of which the increase from 1862 to 1882 was 384 per cent. The area especially devoted to roots and tubercles is 4,260,000 acres, and employs special drills, hoes, and root pullers. The horse hoes, numbering 195,000 in 1882, show an increase of 662 per cent. compared to 1862; from 1882 to 1892 the increase was 34 per cent., which was in proportion with the new land brought into cultivation. In 1882 there were 211,000 thrashing machines, the increase from 1862 being 109 per cent.: from 1882 to 1892 the increase was only 10 per cent. France is pretty well supplied with ploughs, hoes, and thrashing machines. But it is entirely different concerning the drilling machines, mowers, and reaping machines, although their number has been doubled within the last ten years. It must not be forgotten that in France the greater part of the agricultural land is composed of small and medium-sized farms, and that the material which serves for these is not very perfect, for it is constructed by the village blacksmith or the agriculturist himself. It is also necessary to consider the influence of the mode of culture, and the dimensions of the fields, some of which are so small that they cannot be worked economically by machinery. There is also in France a notable area cultivated in terraces or on slopes too steep to permit the employment of machines. Concerning what is called the heavy machines, there is an economical limit to their employment which depends upon the area. It may be said, as a general rule of course, that the common reaping machine has been economically employed when it has worked on 50 or 60 acres a year; the mower on 40 or 50 acres, and the drill on 20 to 30 acres. If we admit that even on so small an area as 50 acres these different machines can be used economically, we see that France could utilise ten times more drills, nine or ten times more mowers, and at least twenty times more reaping machines than she had in 1892—that is to say, that she requires still 468,000 drills, 351,000 mowers, and 465,000 reaping machines. It will be seen that these figures are very reassuring for the future of the machinery industry; and it will be observed that, if France is able to construct drills, she nevertheless remains dependent on foreign workshops for mowers and reaping machines, and it seems to us that she must be so still for a long time to come. Her fashions of manufacturing, her methods of sale, as well as the cost of raw material, are the chief obstacles which prevent France making these machines profitably. The great development of agricultural machines from 1882 to 1892 shows the considerable future which is in store for the English rural engineer.

Bath and West and Southern Counties Society.—The 1899 meeting of this Society will be held at Exeter, and the main lines for the laying out of the show ground have been recently settled on the spot by the Society's stewards. The ground is conveniently situated on the immediate outskirts of the city, and is about forty acres in extent. The Devon Agricultural Association have resolved to forego their show for that year in order to unite with the Society in promoting the success of the Exeter meeting, and they will also make a contribution to the Society's prize list. In return, the Bath and West Society will place the members of the Association upon the same privileged footing as the Society's own members. The Society's Show Dates Committee have resolved to recommend to the Council that the show be opened on Monday, June 5th, and closed on Friday, June 9th.

## RAILWAY MATTERS.

THE Söul-Chemulpo Railway, in Corea, will, it is expected, be opened for traffic at the end of this year.

THERE are 2050 miles of railway in Belgium, and the number of passengers carried annually is about 80,000,000. The number of persons employed in the railway service is about 48,500.

THE four lines of railway affected principally by the coal strike—viz., the Great Western, Taff, Barry, and Rhymney—are said to have suffered in their mineral traffic alone to the extent of £300,000.

THERE were 150 train accidents on the railways of the United States during May, by which 36 persons were killed and 138 injured. The accidents include 68 collisions and 76 derailments, of which 65 are unexplained.

AMONG important railway projects to be carried out in India is a line from Midnapur to the Jherria coalfields, which will be built by the Bengal-Nagpur Railway Company from Jherria. The line will be eventually extended to Hazaribagh and Chota Nagpur plateau, which will be served by two branches on the 2ft. gauge. But a more important line as regards immediate requirements, says *Indian Engineering*, would be one to tap the trans-Damuda coalfield, awaiting only such facilities for speedy development.

ON May 2nd, Georgiana, Marchioness of Aylesbury, laid the keystone of the new tunnel at Savernake, on the Marlborough and Grafton Railway. This railway, which was opened for traffic on Sunday, June 26th last, forms the connecting link between the northern and southern sections of the Midland and South-Western Junction Railway Company's line. The late Mr. Shopland was the engineer for the work, since whose death the work has been carried out under Mr. R. St. George Moore, of Westminster. Messrs. John Aird and Co. were the contractors.

SIGNS of the progressive development of Corea are not wanting, says Mr. Consul-General Jordan. A French engineer has completed a survey of the proposed railway between Söul and Wiju, on the Chinese frontier; and arrangements are being made under purely native auspices for starting a small line in the neighbourhood of Fusan. Further evidence that the spirit of progress has overtaken the Coreans is given by the starting of an electric street tramway in Söul. The tramway company has entered into a contract with an American syndicate for the construction of the road and the supply of the necessary plant.

HER Majesty's Secretary of State for Foreign Affairs has been informed by her Majesty's Consul-General at Christiania that the Norwegian State Railways Administration invite tenders for the delivery of the following:—840 axles with wheels, ten axles, 24 tires, 40 wheel centres. Tenders in sealed envelopes, marked "Hjul," should be addressed to "Styrelsen's Expeditionskontor, Statsbanerne. Christiania," where they should be received by 2.30 p.m. on July 20th, 1898, and where drawings and conditions of delivery can be obtained. A copy of the specification may be inspected, and further particulars may be obtained, on application at the Commercial Department of the Foreign-office, between the hours of 11 a.m. and 5 p.m.

THE works on the Great Western's new line, the Bristol and South Wales Direct Railway, although hindered somewhat by the heavy rains of the spring and early summer, are progressing rapidly. The line commences below Wootton Bassett with a heavy cutting, out of which some 300,000 cubic feet of earth have been taken. Further on some progress has been made in tipping on the embankments, and the foundations of viaducts are being put in. Messrs. Pearsons are the contractors for the work, which will probably occupy quite another eighteen months, although it is already close upon a year since operations were begun. The estimated time for completion was then put at two years. The undertaking, however, is, from the engineering point of view, a heavy one.

THE Bengal-Dooars Railway, a small open metre-gauge line in India, will soon have its mileage—36·40—trebled by the contract which it has entered into with the Secretary of State for the construction and working of three extensions. The present line, which has only been opened a few years, runs from the east bank of the Teesta, opposite Jalpaiguri—which is over 300 miles from Calcutta—to Dam-Dim. The line is now to be extended in three directions, the first being from Malbazaar Station on the existing railway to Hantupara, a distance of 46 miles; the second from Dam-Dim Station to Bagrakote, a distance of 6½ miles; and next from Deomoni Hat to Lalmonir Hat, a distance of 69 miles. These additions to the Bengal-Dooars system, says *Indian Engineering*, will greatly assist in opening up a part of Bengal that has been greatly neglected in the matter of railway extension.

NEVER in the course of their history have the German State Railways been in so prosperous a condition. In Government circles there is talk of constructing separate lines for goods and separate stations for merchandise, so as to relieve the railways for passenger traffic, in order to ensure more safety to the trains, as the German public has been alarmed during the past few years by the increase of railway accidents. It would cost milliards to put this idea into effect; but, of course, to the iron industry as well as to that of carriage building, brilliant future prospects would be opened up. In the meantime orders of truly enormous quantities have already been given by the various railway authorities for the increase of cars. The total surplus of the Prussian State Railways has risen from 469,468,689 marks to 503,899,060 marks—from 6·75 to 7·15 per cent. of the average capital invested, quoted according to statistics.

THE total number of Bills deposited for the parliamentary session of 1898 relating to railways and canals amounted to eighty-two, of which fifty-four proposed to authorise the construction of new railways or additional railway works. The Bills of existing railway and canal companies numbered sixty-four. The new lines proposed showed a length of 487 miles, as against 728 miles in session 1897, and the amount of new capital proposed to be raised was £29,154,410, against £25,649,557. The Bills of the new railway companies numbered eighteen, compared with twenty-five last year; the new lines proposed showed a length of 218 miles, as compared with 207 miles, and the amount of capital proposed to be raised is £11,330,164, as compared with £14,779,232. Together, the existing and new railway companies' Bills numbered eighty-two, as compared with ninety-one; the length of new lines 705 miles, as compared with 935 miles, a decrease of 230 miles; and the amount of capital to be raised £40,484,574, as compared with £40,428,789, an increase of £55,785.

A NEW station has been opened at Felixstowe, on the Great Eastern Railway. The new station, which has cost about £33,000, has been erected much nearer to the town than the old one, and is situated in the locality where developments are likely to take place. It is of an extensive character, the scheme of which it forms part having been designed to meet future requirements. At present, so far as the platforms of running lines are concerned, the scheme has been only partly carried out, but the station buildings are adequate to meet any future development of Felixstowe. One platform has been built with two sides to it, the length being 650ft. and 785ft., and the width 25ft. Provision has been made to carry on goods traffic of considerable magnitude, and a goods shed has been erected 100ft. long by 33ft. wide, with a loading dock for horses and carriages. The plans from which the station has been erected were prepared by Mr. John Wilson, engineer-in-chief of the Great Eastern Railway, and the work was carried out by Messrs. Kirk and Knight, of Sleaford,

## NOTES AND MEMORANDA.

THE number of steam boilers in use in Italy during 1897 was 19,318 for agricultural and industrial purposes; in 1890 there were only 14,502 in use for such purposes.

ACCORDING to a report of the French Minister at Stockholm, the industry of textiles made from peat fibre has just been introduced into Sweden. The fibres, produced from peat by a mechanical process, can be mixed in the proportion of 75 per cent. with pure wool, for the manufacture of yarn similar in appearance to common woollen yarn.

PHOTOGRAPHY without the aid of light sounds paradoxical, but is practicable nevertheless. Dr. W. J. Russell, who communicated to the Royal Society the fact that certain metals and other substances will act on a photographic plate when exposed in darkness, has been successful in taking a large number of photographs without employing actinic rays.

IT has been found by M. H. le Chatelier that the resistance of steel is not influenced by tempering at temperatures below 710 deg., the temperature of recalescence. The resistance after tempering at 850 deg. to 1000 deg. is about double that of the untempered metal. At high temperatures chromium exaggerates the increase of resistance produced by tempering. Tungsten makes practically no difference.

SMALL agitations, due to the running of trains on the South London Electric Railway—the nearest point of which is at a distance of 4¼ miles from Greenwich Observatory—can be traced from the year 1890, but do not seriously interfere with the magnetic registers. A recent proposal to use electricity as the propelling agent on a tram line in the neighbourhood of Deptford—1¼ miles distant—if carried out, would have had serious effects on the magnetic records at Greenwich.

THE United States Consul-General at Berlin says that the area of carriage pavements in that city is 6,500,405 square yards. Of this area a little less than 74 per cent. has stone pavements, about 25 per cent. asphalt, and a fraction over 1 per cent. wood pavement. The proportion of asphalt is steadily increasing. The soil consists of coarse, gritty sand, forming apparently an excellent foundation for the heavy 8in. layer of gravel and cement, over which the 2in. covering of asphalt is spread.

A COMMUNICATION by M. Dubois was recently made to the Paris Academy of Sciences on the electrical resistance of the human body. It appears that the body acts as a condenser with liquid dielectric, of a capacity of about 0·165 microfarad. Under the action of continuous currents the resistance of the body may fall from 51,500 to 3030 ohms. But at any stage of this variable state, if the resistance be measured by a condenser method, with discharge through a ballistic galvanometer, the resistance is found to be invariable, about 400 ohms.

FROM a diplomatic and consular report just issued on the "Trade and Industries of Great Britain in their Relation to those of Foreign Countries," it appears that during the period between 1871—75 and 1891—95 the annual production of iron ore in Great Britain and Ireland is estimated to have decreased from 16,087,000 to 12,249,000 tons. On the other hand, Germany's output of iron ore has more than doubled within the same period, and that of Spain increased nearly ninefold. The production of the United States, which for 1871—75 was estimated at a yearly average of 4,532,000 tons, has increased during the period between 1891—95 to a yearly average of 14,288,000 tons.

IN the current number of the *Comptes Rendus*, M. Moissan, after showing that none of the alkaline earths yield a pure metal, describes two ways of preparing crystallised calcium containing less than 1 per cent. of impurities. The first of the methods depends upon the property possessed by calcium of dissolving in liquid sodium at a dull red heat, and separating out in crystals on cooling. By treating the mass cautiously with absolute alcohol the sodium is removed, and the calcium is obtained in the form of brilliant white hexagonal crystals. Similar white crystals of calcium can be obtained by the electrolysis of fused calcium iodide. It is noteworthy that calcium has usually been described by previous workers as a yellow metal, says *Nature*, doubtless owing to the presence of impurities.

THE largest output of coal in India during the year 1897—1898 was secured in the Bengal Province, from whose mines as many as 3,142,497 tons of coal were taken. This is the heaviest quantity of coal taken from the Bengal collieries in any one year since 1880, the earliest year covered by the report. Next to Bengal the Nizam's territory is the most productive, the coal mines in that province yielding 365,550 tons last year. In all the nine provinces mentioned in the report yielded 4,063,127 tons of coal last year, as against 1,294,221 tons in 1885. Apart from Bengal and the Nizam's territory the following figures represent the output in the other provinces:—Punjab, 92,792 tons; Central Provinces, 131,629 tons; Assam, 185,533 tons; Central India, 124,778 tons; Baluchistan, 8876 tons; Burma, 11,472 tons. In Madras and the North-Western Provinces and Oudh no coal seems to have been secured, although in former years a small output figures in the returns.

WOOD-PULP and timber are the most important articles of export from Christiania and other Norwegian ports. Exports of timber increased during 1897 by about 24,000 cubic metres compared with 1896. Similar favourable results are reported from other timber centres, both prices and shipments exceeding those of the previous year. The total exportation for the whole of Norway amounted to about 2,095,111 cubic metres, against 1,846,098 the year before. Most of the timber was exported to Great Britain, some to Holland and Germany, and an occasional cargo by sailing vessels to South Africa or Australia. Wood-pulp also shows a steady advance on last year, 70,090 tons being shipped from Christiania, compared with 64,302 in 1896. The total exportation of wood-pulp, wet and dry together, was 259,149 tons, and of cellulose 81,156 tons, against 243,815 tons of the former, and 75,180 tons of the latter in 1896. From Christiansand the exportation of this article to the Continent increased 20 per cent., but decreased by 10 per cent. to Great Britain, the continental prices being more favourable.

SCARLET, it has always been supposed, was the worst colour possible for the purposes of the battlefield. It has been said so with such frequency, indeed, that nobody of late years has cared to dispute the fact. We owe it to some very practical experiments carried out in Germany that the question has now been put on a more satisfactory basis. A squad of ten men, two dressed in light grey, two in dark grey, two in scarlet, two in blue, and two in green, were lately ordered to march across an open country. Their movements were closely watched. The first men to disappear from sight were those in light grey, immediately afterwards the scarlet, then the dark grey, and finally the blue and the green. Here we have all well-worn theories upset. Experiments carried out on the rifle range showed that our national colour possesses even distinct merits. The idea was this time to ascertain which colour gave the worst mark for the rifle. Twenty men, all good shots, were used for the purposes of the experiment. After they had fired a given number of rounds it was discovered that scarlet was far the most difficult colour to hit. For every miss at the other colours there were three in favour of scarlet. We will not assert that these experiments were conclusive evidence in favour of our national colour, but they certainly go a long way to justify its retention, says the *Army and Navy Gazette*. There is much to be said in these days of quick-firing guns in favour of a uniform which is difficult to hit, and in this particular scarlet undoubtedly will hold its own against all other colours,

## MISCELLANEA.

ON Tuesday last at Greenwich the Thames Steamboat Company was fined for having a boiler furnace fitted on one of its boats which did not consume its own smoke. Notice of appeal was given.

THE Admiralty have decided to grant an annual subsidy sufficient to cover the interest on capital cost of, and sinking fund for, the complete equipment of the Calliope Dock, Auckland, New Zealand. This dry dock is one of the largest in the world, capable of taking in two warships at the same time, and the Imperial authorities own a large area of land adjacent, for coal and naval depôts. Negotiations have been proceeding for four years. The equipment of the Calliope Dock means a second naval station for the South Pacific.

AN accident occurred on Tuesday, on board the torpedo boat destroyer Desperate, the senior officers' ship in the Medway Instructional Flotilla at Sheerness. The Desperate was running a cruise off Harwich, when one of the tubes of her water-tube boilers gave out, scalding three stokers who were on duty in the boiler-room. Fortunately their injuries are not of a serious character. The Desperate brought the men to Sheerness for hospital treatment. The defect in the boiler tube was plugged by her engine-room staff, and the Desperate was enabled to continue her cruise.

THE long-talked-of telephonic communication between the two capitals, Moscow and St. Petersburg, is likely this year to become an accomplished fact. The undertaking is under the control of the Imperial Telegraph Department, and the stations will be at the chief telegraph-office in either city. As the average speed of ordinary telegrams between Moscow and St. Petersburg, 400 miles, is about ten or twelve hours, the telephone should prove a great boon to business men, who in case of urgency are now obliged to pay three times the ordinary tariff to get their telegrams through as "special" messages.

THERE is to be held an Exhibition of Arts and Industry at Grahamstown, South Africa, in the months of December and January, 1898—99. The British and continental agency for this Exhibition is in the hands of Messrs. William Savage and Sons, of Port Elizabeth, S.A., and of Blomfield House, London Wall, London, E.C. This firm has arranged with the South African and Transvaal Advertising Company, Limited, Effingham House, Arundel-street, Strand, London, W.C., as sub-agents, from whom all information relative to space for exhibits may be had. The exhibition will be international in its scope.

THE past year of 1897, economically considered, may be characterised as highly successful, says Consul-General Sir Charles Oppenheimer, in his report on the trade and commerce of Frankfort-on-the-Main. The upward tendency which gradually set in during 1895 and continued steadily during 1896, without, however, touching all branches, has further developed in 1897. The verdict of this year may be summed up in the remark, "Every chimney was smoking." Not only the high ones belonging to industrial establishments, but also the chimney of the citizen and the stove of the working man and farmer. Germany has already had a fair number of good years; but perhaps in no previous one has she experienced a development resting on such a sound basis.

ACCORDING to a consular report, German bicycle manufacturers make large profits; they pay 20 per cent. dividends and even more, including ample allowances for wear. Nevertheless, this industry demands the introduction of a customs duty of 50 marks per bicycle. In Germany, they assert, about 800,000 cycles are in use; the number is constantly increasing. At present there exist about 150 establishments for cycle making. The capital invested is estimated at 80,000,000 marks, and the number of workmen employed at 40,000. The import of English-made machines has become quite insignificant. The price may have something to do with this, but German wheelmen are said to prefe a lighter machine than ours, although the roads are not so good.

ONE of the most important schemes which have yet been undertaken by the London County Council will be the construction of the long-talked-of and much-needed street connecting the Strand and Holborn. At the meeting of the members of the Council held this week it was decided to apply to Parliament for powers to make a street 100ft. wide, commencing opposite Southampton-row, Holborn, and terminating in a crescent-shaped thoroughfare having openings at Wellington-street, Strand, and near the Law Courts. The estimated cost is £774,000. The widening of Southampton-row, the clearing of the Clare Market site, and the demolition of the block of buildings forming the south side of Holywell-street, Strand, have also been approved by the Council, and will come as a boon to vehicular traffic, besides providing the long-desired removal from the map of London of an excrescence. It is to be hoped that these schemes, which have been on and off the *tapis* since 1892 quite a number of times in somewhat modified forms, will at last become an accomplished fact. The aggregate cost of the complete scheme will be £1,721,000.

THE results of the competitive examination of last April for the entry of engineer students at Keyham College have recently been published, and show that no less than 162 candidates presented themselves for twenty-six vacancies. Twenty-six does not represent the total number of entries, as the Admiralty permit a few nominated candidates to enter the college provided they secure qualifying marks, but even so the entry is a small one, and this is disappointing in view of the recent enlargement of the college. It is evident that the Admiralty could, if they wished, enter many more students, for as many as sixty of the rejected candidates obtained qualifying marks. A very high standard of proficiency was shown by the selected candidates, the lowest on the list obtaining considerably more than half marks. The increased competition for entry to Keyham College indicates that the naval engineering branch is recognised as a good opening for lads of scientific bent, whilst the system of holding the examinations in many of the large cities of the kingdom as well as at the naval ports naturally increases the competition. But whilst the accommodation at Keyham College is so limited the Navy continues to expand, and we are still very deficient in junior engineers. It thus seems necessary that another wing should be built, for we understand, says the *Army and Navy Gazette*, that the college is already full.

PERHAPS the most interesting steel yacht ever built in America was launched recently at the yards of the Jonson Engineering and Foundry Co., New York, says the *Marine Recier*. The vessel is the American, built for Commodore Archibald Watts, who designed her. She is 254ft. over all, 38ft. beam, 21ft. depth of hold, and draws 12½ft. of water. She has two quadruple-expansion engines of 3200-horse power, and her estimated speed is 17 knots per hour. She has a coal capacity of 650 tons, sufficient for a 65-day cruise. An American Government expert is reported to have declared that the hull includes greater precautions against sinking than any battleship afloat, and that the success of Watts' invention will probably lead to many changes in the building of ships for both war and commerce. The yacht has sixteen water-tight compartments on either side of the keel. Above these lower compartments are nine steel bulkheads, which reach to the upper deck, two of them separating the deck-house. The steel keelson is only 4in. narrower than those used in the St. Paul and St. Louis. The frames of the steel ribs are Z-shaped, whereas those in the Maine, reported to have been the strongest vessel of her size in the navy, were L-shaped, although of the same thickness. All the decks are of steel, together with the two deck-houses, which are 70ft. and 40ft. in length respectively. The yacht will carry two 25ft. naphtha launches with alco-vapour motors, one large steam launch, a 31ft. gig, lifeboat and dinghy.

# EXPRESS PASSENGER ENGINES, HIGHLAND RAILWAY

MR. D. JONES, INVERNESS, ENGINEER

(*For description see page* 30)

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## TO CORRESPONDENTS.

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### REPLIES.

J. R.—Certainly not; the resistance is the same.

FOREMAN.—There are dozens of appliances for stopping a cage in the shaft; any firm making winding machinery or pit head gear will supply you with what you want.

### MEETING NEXT WEEK.

THE SELF-PROPELLED TRAFFIC ASSOCIATION, LIVERPOOL AND DISTRICT CENTRE.—Tuesday, July 12th, at 4 p.m., in the Board Room, Chamber of Commerce, Annual General Meeting.

# THE ENGINEER.

*JULY* 8, 1898.

### THE DESTRUCTION OF THE SPANISH FLEET.

THE end has come not only to Admiral Cervera's operations, but to the actual existence of his ships. Like Francis the First at Pavia, he may say, "All has been lost, all except honour." This sentence, indeed, is, perhaps, more true of the Spanish fleet than of the French army, of which it was spoken, for in the case of this fleet it includes not only the actual loss of the ships, but the loss of conditions on which efficiency depends, and the loss of judgment, almost of common sense. This is not being wise after the event. In our number of June 3rd we expressed our wonder at the failure of Spain to use her one formidable element, her body of swift powerful cruisers, to some purpose. First, we wondered at their separation. This rendered them almost useless for fighting in the West Indies. We pointed out, however, that there was a time when Cervera's fleet or division was so placed that had he gone to the Philippines he had some days clear start of anything that could come from America, and that he had abundant strength either to drive away or to defeat Admiral Dewey. We pointed out that instead of this, he had shut himself inside a harbour, round which naturally gathered a sufficient force of American warships to crush him if he should come out. We suggested that difficulty in procuring coals may have crippled his action, but one feature stood clear throughout on which depended all that he could do—namely, the peculiar combination of speed with a considerable measure of strength which belonged to the Spanish cruisers. It was even possible that the fleet, after it was shut up, might escape, for it might slip out and run the gauntlet of the American fleet's fire. Writing to-day, we confess that we can hardly account for the gallant attempt made to break out having had absolutely no promise of success from the commencement. It is difficult to believe that the American ships could have remained under full steam habitually; yet it is clear that they were so when the Spanish fleet came out, for we read that "in a few seconds the American fleet was in motion." Had their fires been banked, it would have been more like three-quarters of an hour before full steam could have been got, and the Spanish ships should by that time have secured a considerable start.

Let us, however, look at what happened. Inside the harbour of Santiago de Cuba lay Admiral Cervera with four armoured cruisers, the Cristobal Colon, the Oquendo, the Vizcaya, and the Infanta Maria Teresa. Outside lay Admiral Sampson with the main strength of the entire United States Navy, including the battleships Iowa, Indiana, Massachusetts, Oregon, and Texas, and the powerful armoured cruisers Brooklyn and New York, besides other vessels of less importance. Admiral Cervera's dash to get out, then, meant the attempt to run four cruisers through the assembled battleships of the United States Navy. One chance, and only one he had. The United States ships, not being able to keep up full steam for successive weeks, ought to be caught with banked fires, and thus if he could run the gauntlet of their batteries he might easily obtain, as we have said, some miles start of them. His speed in theory exceeded that of the great battleships by three knots or more. The Brooklyn and New York, it is true, had one knot higher speed than the Spanish ships; but could they alone or with support only from some possible United States unarmoured cruiser, overhaul and defeat the four Spanish armoured cruisers? Only, we think, if the latter had been heavily injured in passing through the line of battleships. So far as we understand it, this was the position of matters when Admiral Cervera made his gallant but ill-fated dash out of the harbour. At the moment chosen one circumstance favoured the attempt. Admiral Sampson with one of the two swift ships, the New York, was away from the mouth of the harbour. Everything, then, depended on the state of readiness in which the terrible battleships were found. A bold rush, if it could be made absolutely without warning, might succeed. No vessel, in theory, could be better suited to attempt it than these unusually swift and powerful Spanish cruisers. At the moment that Admiral Cervera led the way in the Cristobal Colon, supported by the guns of Fort Morro, especially if he believed that he was taking the Americans by surprise, he may well have had hope of success; but such hope must have been almost extinguished in a few minutes. So instantly did the United States battleships fire and move that we must conclude that if, as they say, they were taken by surprise, they were fortunate enough to have steam up for some other purpose. Beating to quarters and getting up steam could not be accomplished in "a few seconds." Surely such a condition of readiness, as these words argue, must have been apparent to the Spanish in Santiago had they kept a tolerably sharp look out. In a few seconds, however, we are told the Indiana closed on the Cristobal Colon; nevertheless, the latter gallantly passed her, rounding and delivering a broadside, only to come under the fire of the Iowa and Texas, and, lastly, the Oregon and Massachusetts, while the Indiana first, and then also the Brooklyn and Texas, attacked the Oquendo, which immediately followed the Cristobal Colon. The Vizcaya next emerged and followed the Cristobal Colon and Oquendo westward. The Iowa now steamed with the Oquendo, and the Indiana with the Vizcaya. Not a word is said as to the Infanta Maria Teresa coming out at all in any of the accounts, except the bare fact that she with the others had been forced on shore and burnt, as stated in General Shafter's and Admiral Sampson's telegrams.

The thick armour of the Spanish cruisers stood them in good stead, for it may be seen that it enabled them to do all that ought to have been necessary to escape had a real surprise been effected. The chances of escape, however, were greatly decreased now that the United States battleships were actually running with them. True, had all been in good order the Spanish ships should leave them behind at the rate of three miles an hour, but even so it was to be feared that in this process the American fire would cripple their speed. Probably, however, the Spanish speed, like everything else Spanish, had to be terribly discounted. We have, indeed, recently heard on good authority that some of the bottoms of their ships were in a state that baffles description, so that it is probable that the American battleships were actually swifter than their prey, for this was what it had come to. We have noticed the deficiency of quick-fire guns in American battleships, and we think that the fact that the Spanish cruisers passed them with so little damage points the moral to this deficiency; but under the conditions we have before us, the destruction of the Spanish cruisers could only be a matter of time; the process might be faster or slower, but could hardly fail to be sure. The Cristobal Colon was the strongest and most modern Spanish ship, consequently, although she led the way into the zone of danger, she made by far the best struggle to escape. As the vessels steamed along the coast to the west, the Oquendo turned despairingly into a small bay five miles to the west of Santiago, and the Vizcaya followed her. The Indiana and Iowa closed in upon them and set the Vizcaya on fire, and then appear to have pursued the Cristobal Colon, in which Admiral Cervera still raced with the Brooklyn and Oregon—a race which ended in 3000 yards by the Cristobal Colon running on to the rocks, being then on fire.

The capture of half the Spanish war-vessels is to Spain what Sedan and Metz were to France in the Franco-German War. In each case a persistent infatuated rush was made into a trap, which was obvious to lookers on—a rush which was without benefit to Metz, and equally without benefit to Santiago. Here we have not only superior strength, but supplies, foresight, efficiency, information, and good gunnery, all on the side of the American navy. The Americans must, we think, have had at least some inkling of what was likely to come, or if not, were under steam for some other reason, and must have shown evidences of it. To this the Spanish seem to have been blind. The Americans had coal, of which there is reason to question if the Spanish were not short. The American ships seem to have maintained actually higher speed than the Spanish. Their fire was sufficiently well aimed to tell, while the whole of the Spanish fire seems to have been wasted. Even the Chinese at Yalu produced much greater effect with their unsuitable solid steel shot than the Spanish guns on this occasion. This suggests a ghastly possibility. Did the Spanish fire blank, owing to the absence of projectiles? Some shot they doubtless had; even the splashes prove this, but they may have been very few. One killed and two wounded is the reported American loss. Admiral Cervera and those under him have fought like gallant Spanish gentlemen, but we cannot say that the Spanish fleet has acted like a fleet of the end of the nineteenth century.

### HIGH-PRESSURE LOCOMOTIVES.

SOME time ago a Committee was appointed by the Rail-Railway Master Mechanics' Association to inquire into the relations subsisting between the pressures carried in locomotive boilers and the efficiency of the complete machine. The report of the Committee was laid before the Association at the annual meeting held this year in the month of June at Saratoga. The report does not pretend to be conclusive. Indeed, it carefully explains that the inquiry is as yet by no means complete. Certain portions of the document are perhaps unpleasantly didactic, much that is known to every engineer being laid down in the fashion of axioms, which serve, we fancy, no good purpose whatever. But the main body of the report is very straightforward, and its authors have evidently no bias one way or the other. The investigation turned principally on the advisability, or the reverse, of raising the pressure in locomotives from about 160 lb. per square inch to 200 lb. or 250 lb., and all the points for and against the change are discussed very temperately. The experimental part of the inquiry was carried out with two locomotives at Purdue University, which have already been described in these columns.

The view taken by the Committee is that it is impossible to make a change in the locomotive of almost any kind which will not render other changes necessary, and that this circumstance greatly complicates the problem presented for solution. The utility of an augmentation of pressure may depend altogether on

structural alterations concomitant to the rise in pressure. The points in favour of the increase are thus stated:—(1) Smaller cylinders and consequently lighter reciprocating parts. (2) Reduced width of engine outside of cylinders. (3) Reduced first cost of engine. (4) Reduced transportation charge because of reduced weight. (5) A possible gain in the efficiency of the engine, whereby a given power is developed on less steam and on less fuel than could have been done with a lower pressure. Against the higher pressures we have:—(1) Increased weight of boiler. (2) Increased first cost of boiler. (3) Increased transportation charge, due to increased weight of boiler. (4) Probable increase in small heat losses, as from radiation and from leakage past valves and glands. It will be gathered that very little importance appears to be attached to economy of fuel. In the United States that has always been a secondary consideration, whereas in this country great if not undue weight has invariably been attached to a reduction in the consumption of coal per train mile. The Committee seem to think that the saving to be effected by the rise of pressure only is far too small to be worth much; but they favour anything which will enable them to add to the hauling power of the locomotive. It is well known that in Great Britain the dimensions of a locomotive are limited not only by the gauge of the rails, but by the sectional area of tunnels, and the distance between the platforms and the rails. In the United States there has been much greater latitude, and locomotives are in regular use which could not be worked on English lines for lack of room. But even in the United States the limit seems to have been nearly reached, and we find the Committee writing:—"As the steam pressure is increased, the size of the cylinders may be reduced. On many roads, the width of engines over cylinders is already very close to the clearance width along the right of way. On such roads a demand for engines of greater power cannot be met by increasing the diameter of cylinders; hence, resort must be had either to a longer stroke of piston, or to higher steam pressure." The principal object, we had almost written the only object, of change in the construction of the American locomotive is to secure an increase in its efficiency, and thus economy of fuel is not so much regarded as a desirable thing in itself as a means of getting more work out of an engine of given proportions. In effect, the American locomotive superintendent says:—"I do not care about high evaporative efficiency as enabling me to burn less coal per train mile, but I value it very much because it means more steam from the boiler and more power from the engine." On this point the report speaks with no uncertain voice:—"Under normal conditions, a locomotive is worked so near its maximum power that the limit of power is determined by the amount of coal it can burn. If improvement can be had in the process of combustion, or in the more complete absorption of heat, or by a reduction in the amount of fuel lost as sparks, the efficiency of the boiler will be increased, and at the limit of power this improvement in performance can be converted into an increase of power. Again, if the cylinders can be made to better utilise the heat supplied them, they may with a given amount of steam be made to yield greater power. Anything which will operate to improve the efficiency of a locomotive may be employed as a means for increasing its power. If, therefore, increased pressure increases efficiency, it is clear that every interest will be served by its adoption." This line of argument may not fully commend itself to British locomotive superintendents in general; but some of them will, no doubt, endorse the views of the Committee.

An interesting question remains for consideration. To what is the increased efficiency of high-pressure as compared with low-pressure steam due? To this question the Committee are at one with us in returning a dubious answer. In the first place it is not too clear that there is any increase in efficiency, apart from the bare fact that the greater the boiler pressure the heavier is the train which a locomotive can at all events start. It is by no means certain that there is a reduction effected in the consumption of steam per horse-power. Of the two engines tested at Purdue University the best performance of Schenectady No. 2—designed to work at 250 lb.—was much worse than that of Schenectady No. 1, designed to work at 140 lb. only. The reason assigned is that, as the cylinders of No. 2 had to be bushed to 16in. diameter, the ports are too long and the clearance too great. But this very fact emphasises the conclusion that much of the benefit apparently derived from augmented pressure is really due to the better construction of the engine itself. The workmanship must be better for high than low pressures; and very moderate defects in piston rings or valve faces will, we need scarcely stop to point out, neutralise all the saving that might be secured from better methods of working the steam, as, for example, by augmenting the range of expansion. The Committee are fully alive to the facts, for they write:—"There can be no question but that the gradual increase of pressure which has been developing itself for many years past has been accompanied by increased engine efficiency. It is, however, probably true that much of the improvement which has been observed is the result of betterments in mechanism, as well as of advance in the direction of pressure. Pressure constitutes but a single factor affecting the performance of an engine. Equally important with pressure are questions of valve proportions and of valve setting, of cylinder clearance, and of degree of expansion. Moreover, the significance of all of these factors is increased as the pressure is increased." In this country there is reason to believe that the express locomotives working our main-line traffic are about as good as they can be, and not only is this true of them while they are new, they are kept in perfect order in a way almost without a parallel in any other country in the world; and it is, perhaps, because they are so good that no benefit has been derived hitherto from increasing steam pressures above the point necessary to get all the power required out of the engine. In a word, the American locomotive carrying 180 lb. or 200 lb. is a better made machine than one carrying 140 lb. or 160 lb., and to this circumstance, rather than to the rise in pressure, must be attributed the increase in efficiency such as it is.

But there remains to be considered an aspect of the question which cannot be lightly dismissed. We refer to wear and tear and repairs. How will the augmented pressure affect fire boxes, for example? Up to the present no engines have been regularly working at 200 lb. for a period sufficiently extended to enable an opinion derived from actual experience to be expressed. Yet it is easy to see that the higher pressure will at once find out or create defects which might be passed over with the lower pressures. A fire-box might be quite safe with a broken stay here and there so long as the pressure did not exceed 140 lb., which would not be at all safe if the pressure was 200 lb. Tubes, again, a little worn might collapse with the higher pressure, while they would still last for months with the lower pressure. A very few figures will suffice to make this line of argument more convincing. Let us suppose that a fire-box crown sheet is 7ft. long by 4ft. wide. Its area will be 28 square feet, or 4032 square inches; with 200 lb. pressure the total load on the crown sheet is 360 tons; with 140 lb. pressure the load is 252 tons. The 108 tons difference must be provided for, and will not be without its effect on the foundation ring, and every other portion of the fire-box.

In the end, we always arrive at the same goal. The same crucial question always turns up with the practical man—Will it pay? It is but a vain jangle of words to say, the higher the pressure the less the coal burned. To save a couple of pounds of coal per train mile may, after all, be false economy; and not the least suggestive part of the report with which we have dealt is that which points out that if we are going to spend more money on boilers, it is far from certain that a better return will be got by making them stronger to carry heavier pressures, instead of larger so as to have more heating surface.

### ELECTRIC LIGHTING COMPETITION IN LONDON.

A SOMEWHAT singular, and perhaps not unnatural, act of retaliation on the part of electric lighting companies is proposed as a result of the adoption by the House of Commons on second reading of the Bill to confirm the Electric Lighting Provisional Orders granted by the Board of Trade to the Vestries of Marylebone and Bermondsey. It will be remembered that the contention of the opponents of the Bill was that the Electric Lighting Acts never contemplated that a local authority would be allowed to establish a rate-aided competition with companies in which capital had been invested under parliamentary sanction without paying compensation or buying out the existing plant. Section I., however, of the Electric Lighting Act, 1888, provides that there shall be no monopoly, and that another Provisional Order may be given to a local authority or a company in the same area of supply. It was on this basis that the House of Commons, by a majority of eighty-four votes, passed the second reading of the confirmatory Bill in question, the ultimate fate of which has, however, yet to be decided in Committee, to which it has been referred. The efforts of the private companies have, however, been in no way daunted, since they also intend, if possible, to bring about contemporary competition with the local authorities by availing themselves of the same section of the Act that has so far secured the success of the vestries. With this object in view—and only at the last moment required by the Acts—the County of London and Brush Provincial Electric Lighting Company and the Marylebone Electric Supply Company have served notices on the Vestry of Marylebone intimating their intention to apply to the Board of Trade for Provisional Orders for that district. But this is not all, since the Metropolitan Electric Supply Company proposes to invade Islington, and has given a similar notice to the vestry of that extensive district. Mr. W. F. Dewey, the vestry clerk, states that the company desires to obtain its revenge in Islington for its defeat in Marylebone, but that the opposition of the vestry will be sufficient to cause the application to be refused. However that may be, the precedent recently established by the House of Commons, and the service of the three notices already referred to, seem likely to have an important bearing upon the future relations between local authorities and companies in regard to competition in electric lighting in the same areas of supply. At the moment of going to press we learn that the Electric Supply Company has served notices similar to the above on the vestries of St. Pancras and Shoreditch, whilst the County of London and Brush Electric Lighting Company, taking advantage of the recommendations contained in the report of the Joint Parliamentary Committee on the supply of electrical energy, proposes to obtain powers to lay trunk mains through the district of Shoreditch.

### SIX MONTHS' CLYDE SHIPBUILDING.

DURING the half-year now closed Clyde shipbuilders have launched, or shipped in pieces, new tonnage amounting to over 210,000 tons gross, which is by far the best half-year's work ever accomplished in the history of the industry. The output during June alone reached 50,000 tons, which is higher than any of the previous months' outputs. The longer days account, no doubt, for the gain, as compared with previous months this year, but they do not account for the gain over other midsummer months in other years, or for the establishment of the record for the half-year just referred to. Other less obvious matters have helped to the result. The workmen in all branches—even those notorious time losers, "the black squad"—have been working very harmoniously; there have been very few idle since the close of the engineering dispute who wished to work at all, and the employers, both in the shipbuilding and the engineering branches, have done all in their power to clear off arrears due to the strike. Another factor is the proximity of the summer holidays, in view of which extra celerity is customary, both to swell the wage earnings and to round off individual jobs. Big as the June output, and the output for the six months, undoubtedly are, they would have been greater but for the difficulties which have been experienced of late in getting delivery of material, especially in the engine shops, castings, forgings, &c. In the shipyards also the average experience has been such, that what should have been a weekly delivery of plates and angles has only been about once a month. There is still a great amount of work on hand, but prices having stiffened—through advances in material and prospective advances in wages—there has been a falling off in new contracts. Only some 17,000 tons were booked during June. At a conference held in Glasgow on 28th ult., between representatives of the Boilermakers' and Iron Shipbuilders' Society and the Clyde Employers' Association, the questions of an advance of wages and of wilful loss of time by the workmen were discussed and ultimately arranged. The employers granted advances of 5 per cent. on piece rates in shipyards and boiler shops, and 2s. per week on time wages, the increases to be given in two instalments, the second taking effect on August 26th. As regards the matter of lost time, an agreement has been entered into between the society and the employers to assist each other in securing an improvement, and all cases are to be dealt with where it is found that the loss of time is through the man's own fault. Other branches have been granted advances, and the prospects of peace and steady work in the industries have seldom been brighter than they are at present.

## LITERATURE.

*Electro-Dynamics the Direct-current Motor.* By C. A. CARUS-WILSON, M.A. (Cantab.). London: Longmans, Green, and Co. 1898.

THE author is Professor of Electrical Engineering at the McGill University, Montreal, and he points out that the electrical engineer is now confronted with a variety of new problems, for the solution of which he must look to the full development of the science of electro-dynamics, which will in the near future assume the same relation to the electric motor that the science of thermo-dynamics already bears to the steam engine. The aim of the book is to apply the science of electro-dynamics to the direct-current motor. We are glad to find that the author takes for granted a certain acquaintance with the use and design of motors, and does not fill half the book with a repetition of elementary principles, as is the custom of so many authors. He deals first with the induction factor, and with the calculations necessary to find the torque produced by a given motor, supplied with a known current at a known potential. The conditions of uniform motion and the equations for the induction factor are then discussed.

The author gives numerical examples, which he very clearly explains, and these examples are such as would really occur in practice and differ considerably from the purely theoretical problems so often met with in books upon similar subjects. The theory of the shunt-wound motor is then given, and the radical differences between this type and the series-wound type are well explained. As an illustration, a diagram is given of the torque and speed curves of the G. E. 800 railway motor, made by the General Electric Company, and designed to exert a horizontal force of 800 lb. on 33in. wheels when running at 9·4 miles per hour. The very important fact is brought out that if the induction curve of a series-wound motor passes through the origin it cannot be made to generate a current by increasing the speed, and such motors could not be used either as brakes or as generators while descending gradients. The remainder of the work deals more particularly with the laws which require to be observed in the design of motors for railway purposes. Results obtained by Mr. H. S. Hering on two 25-horse power railway motors are given in the form of curves. The author considers the use of series-connected motors for railway work objectionable unless the driving wheels can be fitted with coupling rods. The reader will not find illustrations of any motors whatever, nor are the working dimensions given of any particular forms of motors. The author deals with the general question of design, and suggests certain requirements of speed, torque, acceleration, &c., and then points out how these requirements may be met. The work appeals to a comparatively limited number of readers, and will be found more suitable to the student and to the designer of motors to fulfil special traction requirements than to the man who buys a motor as he would buy any other machine, solely on the ground of output for a given price; the latter will scarcely be assisted in his choice of a particular design. In our opinion, the tendency of the age is to leave the design of motors in the hands of a very limited number of persons; the consulting engineer does not, as a rule, dream of getting out a special design for any particular purpose, but is content to specify some standard type. If, however, the main lines of railways are to be worked by electricity, then there will be as much scope for special designs as there is now in the case of locomotives; and doubtless the future electric locomotive superintendents will incorporate their own ideas in the machines used upon their own lines. The work is a careful discussion of the scientific theory of the direct-current motor, but its value will be appreciated most by persons actually engaged.

*The Calorific Power of Fuels.* By HERMAN POOLE. New York: John Wiley and Sons. London: Chapman and Hall, Limited. 1898.

SCHEURER-KESTNER'S "Pouvoir Calorifique des Combustibles" has served as a basis for the present book. Mr. Poole's work has, however, not been restricted to a translation of Scheurer-Kestner, but includes a good deal of original matter, and is especially rich in tables of calorimetric data collected chiefly from American sources. The book is an example of that class of useful work, viz., compilation and tabulation, in which many American chemists and technologists appear to take great delight. Such work is highly necessary, but not precisely inspiring; we honour the hardy souls to whom it seems to present no terrors, and even to offer some mystic attraction, and we avail ourselves of the fruit of their labour ungrudgingly.

The nature of the book having been thus described and ascertained, we may proceed to its critical examination.

In the introductory chapter some attempt is made to define a calorie, but the author does not specifically

state, as he should, that in modern calorimetry the calorie is commonly taken to be the quantity of heat necessary to raise 1 kilo. of water 1 deg. Cent., at a temperature between 15 deg. Cent. and 20 deg. Cent.; this replaces for convenience the classic unit in which water at 0 deg. Cent. is raised to 1 deg. Cent. The cause of change is, of course, the smaller alteration of the specific heat of water at and about 15 deg. Cent., than close to its solidifying point.

The section on thermometry is scanty, taking no account of methods more modern than that provided by the mercury thermometer. Chapters IV., V., and VI., on various forms of calorimeter, are interesting reading, and contain clear and good descriptions of some of the latest and best forms of this instrument. Much of the matter has necessarily been translated from the French, for it is to French chemists that we are chiefly indebted for improvements in apparatus of this class. The translator's efforts have often succeeded in transplanting a French idiom into the midst of that modernised and improved form of the English language which is in vogue among certain classes of writers in the United States, and is generally employed throughout the book. The effect of refinement and solitude thus produced is piquant, and rewards the appreciative reader.

In Chapter VII. the principal solid fuels are reviewed, their composition and leading characteristics are described, and their suitability for various purposes is discussed. All the information given is compressed into a dozen pages; it is, however, fairly complete, and is probably sufficient for the needs of most users of the book. Liquid fuels are briefly dealt with, and gaseous fuels are treated of somewhat more at length. On page 97 occurs a cross-heading, "Gas of Gasogenes." Being of simple mind, we expected to read something about carbonic acid and aërated drinks, but discovered that gas from various types of producers was the topic to be discussed. The description of the general principles governing the generation of producer gas is on a par with the nomenclature. The section on "Natural Gas" opens with a short paragraph, which for dry cynical humour would be bad to beat. "Natural gas has been known for thousands of years in Asia, on the Caspian Sea, where it has long been a feature in religious services, but it is only recently that it has become of any use to man. . . . ." Any comment of ours would seem clumsy in comparison with this neat satiric stroke, and we abstain.

A section is allotted to the determination of the heating effect of coal burnt under a boiler, and the various observations necessary to be made in a boiler trial are set forth. The information is somewhat scanty in places, notably as regards the question of the determination of the quantity of suspended water in steam. A good deal of space is given to the subject of the examination of flue gases, and various automatic apparatus, such as the dasymeter, for determining the percentage of $CO_2$, and thus giving data for the control of the firing of the boiler, are duly described. The section on pyrometry—a necessary addendum to any scheme of boiler testing—is poor and antiquated. Sound sense marks the comments on that perennially rampant superstition that black smoke means bad economy in boiler firing. Generally, precisely the reverse is true. The admitted mischief of losing combustible gases and suspended carbonaceous matter (soot) is, as a rule, outweighed altogether by the saving effected by restricting the surplus air to reasonable limits. It is on grounds of its interference with health and cleanliness that smoke must be condemned, not because of its supposed wastefulness. A subject of vast practical importance is touched on in the last paragraph on page 176, where the author speaks of the different evaporative effects obtained from fuels differing only in degree of subdivision—large coal usually giving better results than small coal of the same calorific value; no attempt, however, is made to elaborate the theme, and a good opportunity is thus lost.

The book is completed by a long appendix; in this is quoted the report of a Committee of the American Society of Mechanical Engineers on a standard method of conducting boiler trials; it also contains voluminous tables of the calorific values, analyses and other useful data of many various fuels, and is an acceptable addition to the main portion of the work. It is for this, and similar collection and compilation which characterise earlier chapters devoted to the discussion of instruments and methods, that the book will be valued, rather than for any special lucidity of exposition or happy inculcation of sound principles concerning a subject much in need of both to enlighten the average technical reader.

## BOOKS RECEIVED.

*Journal of the Royal United Service Institution.* June, 1898. London: J. J. Keliher and Co. Price 2s.

*Electrical Testing for Telegraph Engineers: With Appendices.* By J. Elton Young. London: *The Electrician* Printing and Publishing Company, Limited. Price 10s. 6d.

*Lectures on the Geometry of Position.* By Theodor Reye. Translated and edited by Thomas F. Holgate, M.A., Ph.D. Part I. London: Macmillan and Co., Limited. 1898. Price 10s. net.

*The Institution of Mechanical Engineers.* Proceedings, 1897; No. 3, July, 1897. Birmingham Jubilee Meeting, No. 4, November. London: Published by the Institution, 19, Victoria-street, S.W.

*The New Roadmaster's Assistant: A Manual of Reference for those having to do with the Permanent Way of American Railroads.* By George Hebard Paine. New York: *The Railroad Gazette.* 1898. Price 1·50 dols.

*Present Day Metallurgical Engineering on the Rand.* By John Yates. With an appendix on the Economics of the Transvaal Gold Mining Industry. By Hennen Jennings. London: Office of *The Mining Journal.* 1898. Price £1 1s.

*Leçons Élémentaires d'Acoustique et d'Optique a l'usage des candidats au Certificat d'études Physiques, Chimique, et Naturelles.* Par Ch. Fabry, Professeur adjoint à la Faculté des Sciences de Marseille. Paris, 1898: Gauthier-Villars et Fils.

*Traité de la Construction, de la Conduite et de l'Entretien des Voitures Automobiles, Publié sous la Direction de Ch. Vigreux.* Par Ch. Milandre and R. P. Bouquet. Premier Volume, Construction. Paris: E. Bernard et Cie. 1898. Prix, cartonné, 4f.

## THE JULY TRAIN SERVICES.

By CHARLES ROUS-MARTEN.

In reviewing the summer train services for the current season, as just announced by the various railway companies, I wish to make it quite clear that I do not deal with the purely commercial side of the matter. I treat the subject entirely from the engineering view-point, in relation to the progress or retrogression revealed by the new timing. Also I do not pretend to undertake a minute or exhaustive analysis of all the train services. That would be a task alike tedious and unprofitable. I simply pass in review the more prominent features of the July alterations.

That these have again come as a disappointment to all who desire to see progress in railway matters—particularly in regard to the matter of speed, which is the special merit and characteristic of railway travel as compared with other modes of transit—must, I fear, be at once admitted. There is no revival of the swift Anglo-Scottish services, which ran so safely and conveniently in 1896. Nor, with few exceptions, do the services between London and all other parts of the kingdom show any acceleration. In several cases, indeed, there has been retardation since last year, while the facts should be borne in mind that Aberdeen is 55 min. more distant from London than it was two years ago; that London is 15 min. farther from Exeter by the absurdly nicknamed "Flying Dutchman" express than it was thirty years ago; and that it takes as long to get from London to Brighton as it did forty years ago, while the travelling times between London and Dover and London and Southampton are slower than they were some years back. There may be good reasons for these decelerations or absence of progress. I do not discuss that point. I merely record the indisputable facts.

Taking the various railways in the order of "Bradshaw"—which remarkable publication comes out this month with 1050 pages, all told—the Great Western is first to appear. Here we find a new and notable feature, perhaps the most interesting of the year. For the first time the Great Western has a train running from London to Birmingham without any intermediate stop. This is the 9.30 a.m., which reaches Birmingham, 129¼ miles, in 2 h. 27 min., giving an average speed of 51·4 miles an hour. This is practically the same speed at which the train ran last year when it stopped at Leamington, allowing 3 min. for loss of time in stopping and starting. So there is no acceleration, but the length of run is a great improvement, and it may be hoped that at a later date we may see the time brought down to 2 h. 15 min.

On the main line westward the 10.30 a.m. Falmouth and Newquay express again makes the long run of 194 miles to Exeter without stop, but the time remains as last year, 3 h. 43 min. A new departure is made, however, with the corresponding up train, which is now timed to make the run in the reverse direction without stopping at Bristol. The same time is allowed as when there was a delay of five minutes at Bristol, so there is a retardation as to actual speed. The time for the 194 miles is 3 h. 53 min., or ten minutes longer than on the down journey. Both the 11.35 a.m. (now 11.30) and the 6.15 p.m. (now 6.10) down trains have five minutes more time allowed than last summer to Torquay, Ilfracombe, and South Wales respectively.

Among the chief new trains are a very good boat express, which starts at 4.30 p.m., running to Cardiff in 3½ hours, and Milford Haven in 6½ hours, connecting there with the Cork steamers, and an excellent Sunday mid-day express from London to Bristol in 2½ hours. The corresponding up train runs without stop from Chippenham to Westbourne Park, 92¾ miles, in 1 hour 54 min. In estimating the engineering merits of these performances due allowance must in fairness be made for the delays caused by the important alterations in the permanent way and stations which have so long been in progress on the Great Western, and are still unfinished.

The London and South-Western, London, Chatham, and Dover, South-Eastern, and Great Eastern lines virtually reproduce their time-tables of last year. So does the London, Brighton, and South Coast, with only one exception calling for notice from my view-point, a new express which runs without stop from Victoria to Fratton, the longest non-stopping run on that line, viz., 86 miles. The time, however, is miserably poor—2 h. 8 min.—representing only 40·6 miles an hour. All these railways provide very frequent and convenient seaside services, and in many cases at a fairly rapid speed, although in the latter respect there is room for improvement. The smartest seaside train out of London is the Great Eastern Cromer express, with its run of 130 miles without a stop, at 49 miles an hour. This is timed exactly as it was last year, but the Great Eastern has expedited by one minute its fastest train, that from Norwich, at 8.45 a.m., to Ipswich, the run of 45½ miles from Trowse being timed to be done in 50 min., or at the rate of 54·3 miles an hour. There is also a non-stopping run from Yarmouth to London, 121¾ miles, but it takes 170 minutes.

On the Great Northern line the principal novelty is the despatch of the Scarborough special express from King's Cross at 11.30 a.m., instead of 10.25, and its acceleration by 10 min. The very smart 1.10 p.m. special express to Cromer in 3¾ h. is revived.

Although the 7.45 East Coast express to Edinburgh and the Highlands is timed to the Scottish capital in 7¾ h. as last year, its intermediate booking is altered in several interesting respects. It begins by running to Peterborough, 76½ miles, in 85 min., the quickest timing from London to that cathedral city since the withdrawal of the 83 min. train which ran in 1896. It follows up this run of 53·8 miles an hour, with a second at 53·3, viz., Peterborough to York, 112 miles, in 126 min., passing Grantham at full speed. At York the North-Eastern takes up the running and goes to Newcastle, 80½ miles, in 95 min.—no very remarkable speed; but next makes the run from Newcastle to Berwick, 67 miles, in 75 min., or at 53·6 miles an hour, the best start-to-stop booking ever yet seen between these two stations. Finally, the North British takes on the train from Berwick to Edinburgh in 63 min., or at 54·8 miles an hour. This is also the fastest timing between those points that has ever appeared in the public time-tables.

Turning to the West Coast Scottish service, a few changes present themselves. Perhaps the most important is the conversion of the 10 a.m. day express into a corridor luncheon train, with the result of eliminating the stop and 20 min. delay at Preston. This is a very wise step, bringing the service up to date, like that of the Midland, by avoiding the annoyance of having to leave one's train and risk one's place in order to obtain any refreshment *en route*.

But, unfortunately, this reform has been made the means of seriously slackening the speed of the train, which reaches Edinburgh and Glasgow, as before, in 8½ and 8¾ hours respectively, notwithstanding the abolition of a stop and 20 min. dead halt. That is to say, the travelling time is increased by 20 min. This is a sad backsliding. As much as 2 h. 59 min. is allowed for the 141¼ miles from Crewe to Carlisle, thus bringing down the speed from 51 miles an hour to 47. Of the 20 min. added to the travelling time 13 min. are allotted to the Crewe-Carlisle run, and the other 7 min. to the Caledonian, between Carlisle and Edinburgh-Glasgow; the 4.30 p.m. from Carlisle, with its two hours' run thence to Edinburgh—100¾ miles—which has been admired for ten years past, having now disappeared. In fact, the entire run of the 10 a.m. beyond Crewe, after remaining unchanged for a whole decade, has now been completely metamorphosed in the direction of slowness. The corresponding up train fares similarly, but the famous runs of 105 min. northward, and 102 min. southward, between Preston and Carlisle, are retained being allotted to other trains.

Several other well-known trains undergo metamorphosis in a different and more satisfactory direction. The Irish boat train, which left at 9.30 a.m., leaves an hour and a-half later, viz., at 11 a.m, and makes up the whole 90 min., reaching Dublin at 9.30 p.m. as before. This indeed is something like a real and substantial acceleration. It calls at Bletchley and Stafford, and runs thence to Holyhead, without stopping at Crewe or Chester, doing the 86¼ miles from Bletchley to Stafford in 102 min.—50·7 miles an hour—and the 130¼ miles, Stafford to Holyhead in 162 min.—48·2 miles an hour. The old 9.30 a.m. train still runs, but as a North Wales express. The other metamorphosed train is the old 10.10 to Manchester and Liverpool, which now starts at 10.15, ceases calling at Rugby and Crewe, but calls instead at Stafford, running thither from Willesden—128 miles—without stop in 2 h. 32 min.—50·5 miles an hour—and then from Stafford to Liverpool, arriving in 4¼ h. from Euston.

The 2.10 express to Liverpool and Manchester now starts 5 min. later and makes up the time. A new 2.30 express leaves for Birmingham and Windermere. The 4.10 "diner" to Liverpool starts 5 min. later, and loses 5 min. in timing as well. A relief train to the Highlands, leaving Euston 7.45 p.m., makes a fast run of two hours from Wigan to Carlisle (105¼ miles), and then, on the Caledonian line, starting from Carlisle at 1.50 a.m., it has a faint reminiscence of the marvellous 1.54 train of 1896, being timed to pass Beattock Summit (50 miles) in 57 min., Carstairs (73¾ miles) in 79 min., and Law (84 miles) in 89 min., averaging 56·6 miles an hour to that point, including the ascent of the Beattock bank. But then it eases off, taking as much as 49 min. to do the remaining 33¾ miles to Stirling. It revives brilliantly thence to Perth, covering the 33 miles, with the Dunblane bank included, in 35 min., or at 56·5 miles an hour, and reaching Perth at 4.45, or in exactly 9 hours from Euston. As the distance is 450 miles, this represents a journey-rate of just 50 miles an hour, including all stoppages.

This is the best thing done for so long a distance. The East Coast time from London to Perth is 5 min. less, but the distance is 9 miles shorter. Apparently the fastest long-distance run is that by the East Coast from King's Cross to Edinburgh, viz., 7¾ hours for the 393 miles, done thrice, and averaging 50·7 miles an hour, including all stoppages; the West Coast, from Euston to Glasgow—Eglinton Station—in 7 h. 55 min., or at 50·6 miles an hour. This, however, is done only once.

That much-abused and erstwhile unpunctual train, the up Perth express due at Euston 7.10 p.m., has been extensively re-timed, as much as 15 min. additional being allowed on the Caledonian from Perth to Carlisle. The 20 min. formerly allowed there for lunch is cut down to 15 min., and then the North-Western makes up the other 10 min. to London, the obstructive stops at Nuneaton and Bletchley being cut out, thus gaining a clear run from Crewe to Willesden in 2 h. 57 min.—152½ miles. This should be a great improvement, although the extensive slowing on the Caledonian is not easily explicable. At any rate, the altered timing is creditable to the North-Western. The 9.45 a.m. up from Liverpool has the Rugby stop taken out, and so makes the total journey to Euston in 4¼ h. It is a remarkable feature of this season's timing that so many trains pass, without stopping, such important stations as Rugby, Crewe, Preston, and Chester, involving a greatly-increased number of long non-stopping runs.

There are few other novelties of special interest, but the North-Eastern deserves credit for its 50 min. run each way between York and Scarborough (42 miles) = 50·4 miles an hour. I have already dealt with the other salient points of North-Eastern timing, as also of North British and Caledonian in connection with the long-distance through services. It should, however, be mentioned that the North British provides a new and very good service from the principal cities and towns on its system to Craigendoran, whence fast steamers run to Rothsay, the Kyles of Bute, and other favourite maritime resorts. One of these trains makes the run from Edinburgh to Dumbarton without stopping at Glasgow, 58½ miles in 78 min.; and the afternoon boat-trains run from Glasgow

to Craigendoran Pier, 24 miles, in 28 min., or at 51·4 miles an hour. Also the 5.50 a.m. North British express from Glasgow to Dundee and Aberdeen has been accelerated 50 min., starting at 6.30, and reaching Aberdeen as before. This train runs from Glasgow to Dundee, 87 miles, in 2 h. 7 min., with three stops.

So far as I can ascertain, the fastest main-line runs provided this month by the various lines are as follow, only those at 54 miles an hour or more from start to stop being included:—

| | Miles. | Min. | Speed. |
|---|---|---|---|
| Caledonian ... ... ... ... | 32½ ... | 33 ... | 59·1 |
| ,, ... ... ... ... | 33 ... | 35 ... | 56·5 (2) |
| ,, ... ... ... ... | 32½ ... | 35 ... | 55·7 |
| ,, ... ... ... ... | 89½ ... | 97 ... | 55·6 |
| Great Northern ... ... ... | 73½ ... | 80 ... | 55·3 |
| ,, ... ... ... | 25½ ... | 29 ... | 55·3 |
| North British ... ... ... | 57½ ... | 63 ... | 54·8 |
| Great Northern ... ... ... | 82½ ... | 91 ... | 54·5 |
| London and South-Western | 14½ ... | 16 ... | 54·4 |
| Great Eastern ... ... ... | 45½ ... | 50 ... | 54·3 |
| North-Eastern ... ... ... | 44½ ... | 49 ... | 54·1 |
| Great Northern ... ... ... | 105½ ... | 117 ... | 54·1 |
| ,, ... ... ... | 50½ ... | 56 ... | 54·1 |

It may be remarked that we have not one single run timed as fast as 54 miles an hour for the first stage out of London, whereas the Northern Railway of France alone has no fewer than three timed at over 54 miles an hour for the first stage out of Paris, the respective speeds being 57·7, 56·4, and 54·5. This is not a pleasant contrast for us.

## DR. CORNELIUS HERZ.

THE death is announced of Dr. Cornelius Herz, which took place at Bournemouth on the 6th inst., and whose name must not be confounded with that of Dr. Heinrich Hertz, as it has been more than once, because both have been prominently before the world as electricians. Dr. Herz was born at Besançon in 1845, and graduated in medicine in Germany. After the Franco-German war he went to the United States, became naturalised, and married an American girl. His position in the world of science was due to the very prominent part which he took in working the Marcel-Despretz patents for transmitting power by electricity, and after many difficulties he succeeded in getting the powerful aid of the Rothschilds, and finally made a good deal of money. He laboured with unsurpassed energy to improve and develope the telephone, and it has been claimed for him that he was the first to make long-distance transmission a commercial possibility. In 1880 he received the Grand Cross of the Legion of Honour, and ranked among the most prominent men in France. Of his connection with the Panama scandal we prefer not to speak. He was beyond question a very able man, but he loved science not for its own sake, but as a means of making money. His energy was indomitable, and the fatigues and privations through which he passed in the earlier part of his life, and the tremendous anxieties of its close, no doubt killed him at a comparatively early age. He died of angina pectoris after many months of severe suffering.

## THE COAL STRIKE.

IN response to the appeal of "Mabon" and others to the President of the Board of Trade, for the appointment of a Conciliator, Mr. Ritchie has named Sir Edward Fry, formerly a High Court Judge, who is now presumably engaged in the investigation of the leading points of the dispute. Sir Edward Fry has written "Mabon" and the owners' secretary announcing his appointment. The owners' secretary has convened a meeting of the Emergency Committee for Saturday, to decide on the course to be followed, and meanwhile, he has issued a manifesto blaming the men for the stoppage. They are willing to discuss matters, but the leaders of the men are not to be trusted. No settlement is possible until fully authorised representatives are appointed. The distress is regretted, but would be greater if the coal-owners were forced into concessions which would result in closing many large collieries and throwing thousands out of employment.

On Monday, an important meeting of representatives for the whole of the South Wales coalfield was held in Cardiff, Mr. Abraham ("Mabon"), M.P., presiding. The delegates represented 93,713 workmen. After the object of the gathering had been read, which was to take into consideration the Act, and the suggestion to contract out, and a lengthy discussion had taken place, the following resolution was carried: "That the workmen should be recommended strongly not to contract out; that a ballot should be taken after a resumption of work, and that the Provident Fund Society should be requested to take no action to test the opinion of the members for the time being, and that the men should be recommended strongly to continue their membership of the provident fund."

At an important meeting last week of enginemen and stokers it was decided not to give notice but to continue working, so as to keep the mines in order for a re-start. This is the most hopeful augury in the situation.

It has oozed out from the ranks of the colliers that the appointment of a Conciliator by the President of the Board of Trade has led to a slight "stiffening of backs." A well-informed authority in Cardiff states that there was a little while ago a disposition amongst the colliers to support a 5 per cent. advance and a sliding scale, but that it is now suggested that 10 per cent. and no scale might be attainable, while others regard a still larger advance as within likely bounds. If the appointment should lead to the indulgence in most improbable expectations, it will be generally deprecated. No opinion has yet been expressed publicly upon the appointment by the Associated owners.

The men employed at Ystrad Mynach Colliery came out on strike on Tuesday in consequence of the owner arranging to return to the single-shift system, by which the workmen pleaded they would lose 2d. per ton.

The result of the ballot amongst the North of England and Scottish miners has been in favour of a demand before the London Conference this week for a 10 per cent. advance. This was supported by 95 per cent. of the Association, which now numbers 300,000 miners, and includes Scotland; Yorkshire, with 85,000; Lancashire, with 70,000; the Midland Federation, including Cannock Chase, North Staffordshire, and Warwickshire, 50,000; Derbyshire, 30,000; Nottinghamshire, 18,000; North Wales, 11,000; and Cumberland, 7000. The last agitation was in 1893, when a strike ensued upon a refusal to grant the integrity of the 40 per cent. advance which the colliers had built up on the prices of 1888. The strike lasted sixteen weeks, and ended in favour of the owners. The wording of the notice to the ballot was:—"First, are you in favour of an application for a 10 per cent. advance; and, secondly, are you prepared to give the Executive Committee or Special Conference the power of stating when notice shall be given to secure it?"

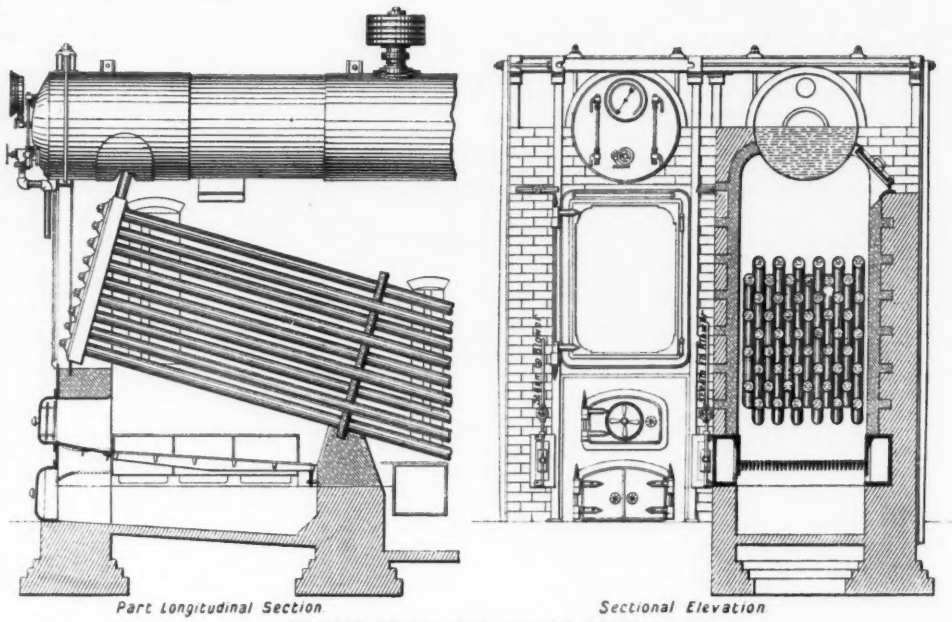
The Newport carpenters on strike have come to an arrangement, and will return forthwith to work with the stipulation that they are not to be expected to work after 5 p.m.

The opinion expressed in THE ENGINEER last week, that as the strength of a chain was its weakest link, so the capacity of the smallest coalowner might be regarded as the limit of endurance in the present struggle, has been favourably discussed in managerial circles, the only remark being that in this case, without invalidating the force of the illustration, the Association is so constructed that the strong will support the weak, and the accumulated funds meet all losses.

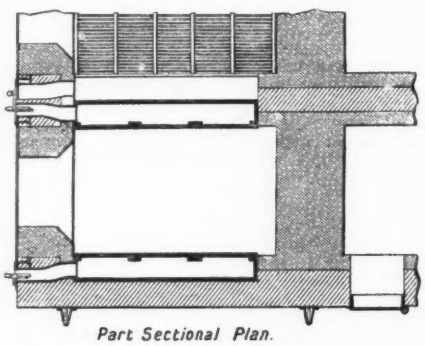
## THE HORSFALL INDUCED DRAUGHT SYSTEM.

METHODS of improving defective draught in boiler furnaces are usually based upon one of the two following systems: forcing air under the fire-bars by means of fans, or inducing it into the ashpit through the medium of steam jets. A system having somewhat novel features, which are claimed to be particularly valuable in their application to boilers of the Babcock type, where defective chimney construction has rendered steam raising difficult, has been applied to a pair of Babcock boilers at the works of Messrs. Gilman and Spencer, Limited, foodstuff makers, Rotherhithe. In this case a steam-jet blower is applied to deliver air into two cast iron side boxes, or tuyeres, forming the sides of the furnace for about 3in. above and 3in. below the bars. Air and steam mixed are blown through these side boxes and delivered into the ashpits below the grate-bars, there being no outlet for air above the grates. This arrangement serves a double purpose in providing a metallic side to the furnace in the part where the clinker comes in contact with it, and at the part where it has been found to damage the brickwork sides very rapidly, while at the same time the air in passing through the side boxes is warmed before passing through the furnace. It has been found in brickwork side furnaces that the clinker formed upon the grate sticks to the brickwork sides, and on being removed from them by the operation of clinkering causes pieces of the brickwork to be broken away, thus undermining the side wall of the furnace. With the metallic sides above described, which are kept cool by the air and steam passing through them, it is claimed that this action cannot take place, and not only is the furnace protected from damage, but the clinker is more easily removed. The face plates of the side boxes, or tuyeres, are made in separate pieces which are wedged up into position, and which can be easily removed and renewed as required. It will be noticed by reference to the illustration that the outlets for air into the ash-pit extend practically along the whole side of the furnace, thus ensuring a perfectly even distribution of air to the under side of the grate. This is an important feature, giving an even pressure of air throughout the ashpit. It will be noticed that the steam-jet blowers themselves are of a peculiar construction, the orifices being of a thin oblong shape, and being adjustable so as to regulate the thickness of the issuing jet of steam, by which means a sheet or ribbon of steam issues instead of a plug of steam as when round nozzles are used.

It is claimed that as the air is forced through the trumpet mainly by surface friction between the jet of steam and the surrounding column of air, a thin flat jet is more efficient than a round jet, because it presents a much larger surface of contact for the same weight of steam. Moreover, a flat nozzle being adjustable at the orifice, it is possible to regulate the force of the jet with great nicety without wire-drawing it or reducing its velocity. An advantage common to all forms of steam jet furnaces is that the grate-bars are made to last longer than they would under natural draught, because of the cooling action of the steam which reaches them in the form of moisture, and which, coming into contact with the hot under surface of the grate-bars, immediately evaporates, thus carrying off heat and keeping the bars comparatively cool. Further, as the combustion is promoted by pressure of air below the grate, instead of by suction from above, the dampers can be closed to such an extent that there is little or no tendency to suck cold air into the furnace when the firing doors are opened for working the fire. The makers of this apparatus are Messrs. the Horsfall Furnace Syndicate, Limited, Leeds.




BABCOCK BOILER, WITH INDUCED DRAUGHT




## MOTOR CAR NOTES.

A SPECIAL general meeting of the members of the Self-Propelled Traffic Association was held on Monday, at Cannon-street Hotel, to consider a proposal for amalgamation or fusion with the Automobile Club of Great Britain. Sir David Salomons, who presided, explained that the idea of the amalgamation originated with Mr. R. Wallace, Q.C., who suggested that the cause they all had at heart would be advanced thereby. The new organisation would not merely be a club, but what was called in France a Society of Encouragement. If the proposed fusion were agreed to, the members of this Association would be asked to fill up a form of application for membership of the Automobile Club. These applications would be submitted to a Joint Committee of both bodies, and he did not suppose that many, if any, of them would be rejected. The amalgamated body would have a club-house in London for the use of its town and country members, and all the benefits this Association enjoyed from its official connection with the French and Belgian clubs would be granted to the Automobile Club. He concluded by moving a resolution authorising the Council to take the necessary steps to carry the proposed amalgamation into effect. Mr. Boverton Redwood, in seconding the resolution, expressed satisfaction that the friction which had existed between the two bodies had at last been removed, and said he considered that the amalgamation would be of mutual advantage. The resolution was agreed to unanimously.

## CATALOGUES.

The Ingersoll-Sergeant Drill Company. Illustrated catalogue, No. 41, of mining machinery, rock drills, air compressors, stone channelling machines, quarry bars, gadders, quarrying machines, coal cutters, &c. This is a handsome work of over 200 pages.

Tangyes Limited, Birmingham. This 1898 Factor's Catalogue replaces and cancels the General Section 1891 edition, which is now obsolete. It is devoted chiefly to illustrating and describing their blocks, jacks, crabs, hand pumps, and general smaller manufactures. The book, besides being of handy size, is well printed and bound.

Ashmore, Benson, Pease, and Co., Limited, Stockton-on-Tees. We have received from this company a copy of a new edition of their "Gasholder Catalogue," showing some of the more recent cable-guided holders, which have been constructed by them. The book is nicely appointed, and the contents are arranged in such a manner as to render them interesting reading.

IT is not expected that the United States navy will again resume the speed-premium practice in awarding contracts for warships, although there has been some rumour of it. The practice was strongly deprecated the other day in a prominent after-dinner speech by Rear-Admiral Gherardi, retired, who did not hesitate to remark that in speed-premium tests boilers and machinery of warships were often irreparably injured; one such test, he said, was more injurious to a battleship than three years of hard service, and it would be far better, after some of those tremendous tests, to rip out the boilers and engines and put new ones in. It was the wild extravagance and folly of the officers of the American navy to possess the fastest thing afloat that prompted those dangerous and ill-advised tests.

## DOUBLE-DECK ELECTRIC TRAMCAR

### DOUBLE-DECK ELECTRIC TRAMCAR.

TRAMCARS with seats on the roof are in use to but a limited extent in the United States, owing very largely to the headway being limited by railway bridges over the suburban and country roads and by elevated railways in some of the cities. Some very large cars of this pattern are, however, being introduced for suburban service, and are peculiar in having the entrances at the middle instead of at the ends.

The car shown in the accompanying illustration is of this type, and is further peculiar in having the framing and panelling of steel shapes and plates, being lighter than wooden cars of the same size. It is 34ft. long and 7ft. wide over the frames, the extreme dimensions being 35ft. 8in. in length and 7ft. 11½in. in width. The height is 13ft. 6in. to the bases of the trolley poles, and the car weighs about nine or ten tons. The body has two compartments, entered by doorways from the central platform, so that there are no through draughts in winter. A winding stairway leads from the platform to the upper deck, which has a double row of longitudinal seats, set back to back. This upper deck is roofed over, and in the winter portable panels and sashes are fitted in to make it as protected as the body of the car. At each end of the upper deck is a motorman's cabin, with cords leading up to the trolley pole, by means of which the motorman can replace it if the trolley should slip off the wire. There is a trolley at each end. The car is lighted by electricity, and has push buttons by which the passengers can signal the motorman to stop the car. There is seating capacity for thirty-six passengers inside and forty-four on the roof.

The car is mounted on two four-wheeled trucks or bogies, with a 40-horse power Westinghouse motor on each axle, although on the level lines around Chicago two motors are amply sufficient. The bogies have steel frames, with two coiled springs to each axle box, and elliptical springs under the ends of the bolsters. Brakes are fitted to all the wheels. The car was built by the C. L. Pullman Car Company—not the Pullman Palace Car Company—which has had cars of this kind in use since 1893.

## HARBOURS AND WATERWAYS.

*Cardiff.*—The promoters of the Windsor Dock, who practically are the Taff Vale Railway Company, have succeeded in their third attempt in getting their Bill passed by the Committee of the House of Commons. The conditions imposed by the Committee are considered, however, by the promoters as very onerous. They provide that the Cardiff Railway Company, formerly known as the Bute Docks Company, which was the principal opponent, is to have running powers over the Taff Vale Railway system to the coal pits and to the Penarth and Windsor docks, thus putting the traffic between the coal pits and the port in the hands of both the Bute and Taff companies. Subject to the decision of the Board of Trade, the mud flats are to be dredged to such an extent as to admit of the small vessels which will be displaced by the construction of the dock obtaining an anchorage; if it is found necessary, the channel approach to the dock is to be widened at the expense of the company, and also the facilities of Ely Harbour are to be preserved for the class of vessels which now use the harbour. The Cardiff Railway is, however, not satisfied with the concession made to it, and it is understood that the Bill will be as strongly opposed in the House of Lords as it was in the Commons.

The area of the proposed dock, as brought forward this session, is to be 42½ acres, and of sufficient width to allow of a steamer 1000ft. in length to swing when there are vessels at the berths on each side. The entrance lock is to be 1000ft. long and 100ft. wide. The estimated cost is £1,500,000, and seven years is given for the time of completion. The works comprise the diversion of the river Ely, a large bend of which is to be cut off and form part of the dock.

The contract for the new Bute Dock, the Act for which was obtained in 1894, has at last been let, Messrs. Topham, Jones, and Railton having obtained the contract at £550,000, or about £100,000 below the engineer's estimate. The other tenders varied from £627,000. The time for completion is four years.

The new Barry Dock, which was commenced in 1894, is approaching completion, and it is expected that it will be ready for opening in the course of a few months.

*Liverpool.*—A new departure has been taken by the Mersey Docks and Harbour Board in deciding to let by contract the works required in the construction of some new sheds and making improvements at the Queen's, Trafalgar, and Victoria docks, at a cost of £30,000. Hitherto it has been the practice to carry out nearly all the work of this description by the Board's own staff; but it was pointed out by the chairman that the works already in progress, and about to be undertaken, were so heavy that it must lead to considerable delay if these additional works were also imposed upon them, while the further accommodation to be given by these new works was immediately necessary; every large line of steamers at the North Docks was continually asking for increased accommodation; the coasting trade at the Central Docks also wanted more, while the grain required further storage room; trade was continually increasing, and had overrun the provision for it, and the Board were not able to catch it up; it was therefore necessary to obtain outside assistance to get on with the work absolutely required to be done without delay.

The excavations for the new Canada graving dock are now completed, and the walls and entrances are in a forward state, the Board having given a premium to the contractors to get the work completed within the stipulated time by carrying on the work night and day. The length of this dock is to be 920ft., and the width at bottom and entrance 94ft., with 32ft. on the sill at ordinary spring tides, the floor being 4ft. lower. This dock will be the largest yet constructed, being 120ft. longer than the Prince of Wales Graving Dock at Southampton. The quantity of water to be pumped out will be 21,000,000 gallons, which is to be removed by the pumps in 1⅔ hour.

The Bill for the construction of the five branch docks and the three new graving docks, and the enlargement and improvement of six of the existing docks, at a cost of £3,562,000, has passed through both Houses of Parliament without opposition.

*Bristol.*—It will be remembered that last year the Corporation decided by a considerable majority to construct a new deep-water dock at Avonmouth at an estimated cost of a million and a-half of money, and it was intended to have proceeded with a Bill for obtaining the necessary powers in the present session. Owing, however, to the failure of the completion of certain negotiations then pending with the Great Western Railway Company, it was finally found necessary to postpone the proceedings in Parliament. Subsequently the railway company declined to concur in the proposed scheme on the ground that the new dock would probably result in diverting traffic from the City Docks, where the company is now spending about half a million of money in improving the facilities for traffic; also because they considered that Portishead, where they have a monopoly of the traffic, is the proper place for the construction of a deep-water dock, both on the ground of convenience and economy, the opinion of Sir John Wolfe Barry, in the report he made to the Corporation, being quoted as confirming this; and, generally, that the company could not concur in promoting a scheme about the desirability of which, as compared with the other plan of dockising the river Avon, there seems to be so much division of opinion in the city. The matter having been referred back to the Dock Committee, the engineer was directed fully to report as to the cost and facilities afforded by the various schemes which had been brought forward. The Avonmouth plan included a dock of 35 acres, with a lock of 800ft. by 85ft. wide, and depth on the sill of 40ft. at neap tides, with a graving dock and low-water pier, the estimated cost being £1,500,000. The cost of constructing a dam and lock across the river, and dockising the channel, was £1,865,000, or, as amended by Sir J. Wolfe Barry, £2,000,000. Dockisation would allow vessels of 450ft. in length navigating to Bristol, as against 330ft. at the present time, but, arrived at Bristol, there would be no provision for berthing or swinging vessels of this size. This plan would also involve costly works for the diversion of the sewage and the escape of flood waters. The practical outcome of the consideration by the Committee of the whole matter was that when the works now in operation for improving the access to the Avonmouth Dock are completed, there will be sufficient accommodation for all the trade likely to come to Bristol for many years to come, and that they were not prepared to advise the carrying out of any large scheme until some more favourable terms could be arranged with the railway companies as to rates and as to the requirements of the Great Western as to Portishead. The more progressive members of the Council were not, however, satisfied with this cautious policy, and an amendment was carried by 39 votes to 15, referring the matter back to the Dock Committee for the purpose of their submitting, at an early date, an extension scheme at either Avonmouth or Portishead, or for the dockisation of the river. Thrice during the last six years the Corporation have approved of schemes for dealing with this question, and each time the proposals have been abandoned. Much of the difficulty in dealing with this matter arises from the fact of there being three separate systems of docks, two of which are at the mouth of the river—a state of affairs brought about by the lack of enterprise on the part of the Corporation in not providing accommodation for the larger class of vessels, resulting in the construction of the Avonmouth and Portishead docks by two different companies. After a time of ruinous competition for some years between the Corporation and the companies both undertakings were acquired by the Corporation. Since 1884, when the docks at the mouth of the river were purchased, the Corporation has spent £1,500,000 of capital, including their purchase money, the revenue having in some years to be supplemented from the city rates to cover the outgoings. The two lower docks have always hitherto been worked at a loss. During the past year there was, however, an improvement, the excess of the dock income and expenditure being £1985, after paying sinking-fund charges and allowing for renewals and depreciation. The works now in progress are the improvement of the river in easing the worst curves in the channel, the construction of a new granary at Avonmouth, and the lengthening of the lock. Extensive cold storage sheds at Avonmouth have also been completed, the capital expenditure for the year amounting to £70,486. Of the 792,504 foreign tonnage which came to Bristol last year 547,068 went up to the City Docks, 228,223 went to Avonmouth, and 17,213 to Portishead. Of the grain imports 2,220,078 quarters went to Bristol, 930,206 to Avonmouth, and 123,283 to Portishead.

*Sunderland.*—Owing to the large increase in the traffic to this port, the River Wear Commissioners have under consideration extensive alterations and additions to their docks, at an estimated cost of £375,000. In order to provide for the increased accommodation required for the large steamers which recently have been coming to load cargoes of coal at the South Docks, it is proposed to construct a new jetty 400ft. in length, with four sets of coal spouts on each side, enabling an increased loading capacity of 500,000 tons a year;

the enlargement of the Hudson North Dock; the construction of a deeper and wider entrance; a new graving dock, and additional quays and sidings.

*Suez Canal.*—The report recently presented at the annual meeting of this company, held at Paris, shows that during the year to which it refers there was a considerable falling off in the traffic, due to the famine and plague in India, and the drought and mortality in cattle in the Australian Colonies. The export of Indian wheat to England fell from 447,000 tons in 1895 to 29,000 tons, and the exports of rice fell from 211,000 tons to 144,000; the exports between British ports and India, Burma, and Ceylon showed a falling off of 744,000 tons. The number of vessels passing through the canal was 2986, as compared with 3409 in 1896, and the tonnage 11,123,403 against 12,039,158. Passengers decreased from 308,241 to 191,224. The diminution in receipts amounted to nearly a quarter of a million sterling. Of the total number of merchant vessels passing through the canal in 1897, 74 per cent. were British, 10·6 per cent. were German; France, Holland, and Norway combined furnished 9·7 per cent. In 1895 Japan was represented by only two merchant vessels, while last year 134 Japanese vessels, with an aggregate tonnage of 106,300, used the canal. The maximum draught allowed now is 25ft. 7in., and 391 vessels, or over 13 per cent., drawing more than 24ft. 7in., passed through, as compared with 360 in 1896. The large steamers of 10,000 tons on the Australian service passed through several times in the course of the year without difficulty, as did the Japanese ironclads Fuji and Yashima, with beams of 73ft., being the largest vessels which have so far made use of the canal.

*The North Sea and Baltic Canal.*—The result of the third year's working of this waterway shows an increase both in the number of vessels and tonnage. The vessels using the canal have increased from 9960 to 23,108, and the tonnage from 1,848,458 to 2,469,795. The average tonnage of the steamers using the canal was 205·19, as against 169·84 in the previous year, and of sailing vessels 39·52 against 37·78 registered tonnage. Of the total tonnage 69·5 per cent. belonged to Germany, 8·08 per cent. to England, and about the same to Denmark and Sweden, and from 2·87 per cent. to 2·30 per cent. to Norway, Russia, and Holland.

*The Danube.*—It has been decided by the European Commission to improve still further the navigation of the Sulina branch of this river by making a cutting five miles long, 400ft. wide, and 20ft. deep. This, together with previous works of the same character, will make the channel almost a straight waterway thirty-five miles in length from the mouth to the Tultcha branch of the main river, or ten miles shorter than it was when the improvements first commenced about forty years ago, and with an increased navigable depth of 11ft. At the present time vessels of 3000 tons burthen can without difficulty navigate the river from the great grain exporting ports of Braila and Galatz to the sea. The tonnage has increased from about 450,000 tons to 1,800.000 tons, of which as much as two-thirds belongs to this country.

## A DISCUSSION ON RAILS.

In the January "Proceedings" of the Western Railway Club is published a discussion on Rails, written by Mr. P. H. Dudley, which, in view of the knowledge of the author is given at considerable length.

The first question is, "What is the most economical rail for railroads with heavy traffic?" The best contribution I can make to the discussion of this question will be to relate the improvements in the tracks which have taken place in the past fifteen years, as shown by my track inspection, which now covers a period of twenty years. The mechanism for summing up all the undulations in the track was completed for the annual inspection of 1881, and since then we have the annual condensed diagrams to date of the same roads, which show the improvements from year to year. Going over the same track for two or three years where great efforts had been made to improve them by labour, the results not being up to the expectations of the railway officials, it was evident that the rails were not stiff enough for the constantly increasing traffic. The undulations on the best track were over 5ft. per mile: while on the poorest the average was 12ft. per mile; the general average being about 8ft. per mile.

It is now fifteen years ago since I designed the pioneer 5in. 80 lb. rail for the New York Central and Hudson River Railroad. With 2·3 per cent. more metal the stiffness of the 80 lb. rail would be 66 per cent. more than the 65 lb. rail, which would be a very important factor in maintenance and the movement of the traffic. The pioneer 80 lb. rail on the New York Central, was replaced in 1892 by a 6in. 100 lb. rail on the Harlem Line. Three years ago a trial of the 6in. 100 lb. rail was made for the interlocking switches in the Grand Central yard, which proved so satisfactory that since then all important points and connections have been laid with it. The switch points retain their position, do not become bent or sag, and work easier than the lighter points or rails.

The movements of locomotives and cars are so constant, the trackmen can do little to the track during week days. Surfacing a 100 lb. rail once per year in the yard suffices to keep the track in good condition, while the 80 lb. rail required to be surfaced from four to five times per year. The undulations in the 100 lb. rail reduce to 1ft. 6in. to 1ft. 9in. per mile in the main line of the New York Central and Hudson Railroad under my care, a joint rarely being indicated as the car passes over it.

The 100 lb. 6in. rail provides for some increase in traffic, and is without question the most economical rail for the heavy traffic of the Hudson division.

The Boston and Albany Railroad for the past twenty years has been raising its standard of track. Twenty years ago the entire line was laid with 4in. 63 lb. rail and supported joints. In 1880 it adopted a 72 lb. 4½in. rail. On neither section was it able to maintain on the heavy gradients for any length of time a high standard of track. In 1890 it adopted a 95 lb. broad-headed rail 5⅞in. high, and laid 10,000 tons in 1891. It has laid several miles each succeeding season, completing the entire line this year. The inspection of the track last October showed a uniform condition of track for the entire line, irrespective of the heavy gradients over the mountains. All the rails are low phosphorus and high carbon, and wear so smooth that the undulations in the rails laid in 1891 were less this year than in 1891. It takes about two seasons before these rails reach their highest standard of surface. I personally superintended the manufacture of all the rails, paid great attention to proper pooling on the hot beds, had all the anvils in the straightening presses lengthened, the blocks being not less than 40in. centres, and forty-four was used much of the time. This permitted the rails to be straightened without excessive gagging, the rails being well finished. The results of the decrease of cost of maintenance and operation leave no question as to the economy of using the 95 lb. rail for this line. In 1883, after I had designed the pioneer 5in. 80 lb. rail, but before one had been laid in the track, I calculated the possible conditions of track for 5in. smooth broad-topped rails, as between the 14th and 16th line on my condensed diagrams; this meant rail not over two years' service. This year the average per mile for the Boston and Albany's entire line is 15·42, notwithstanding many rails have had six, five, four, and three years' service. The results are as gratifying as they are astonishing.

Heavy rails should be finished smooth, far more attention being paid to that feature than is usually the case. The Boston and Albany Railroad has reduced its average undulations per mile from 8ft. in 1881 to 2ft. 2in. in 1897. The New York Central and Hudson River Railroad pioneer 5in. 80 lb. rail was all straightened on presses with narrow supports, and never reduced in the track to their proper value; 1ft. to 1½ft. or undulations per mile being due to the wavy surface from the gagging. The dynamic effects of every wheel load passing over the rails is thereby increased. All the rails it uses from my series of sections are straightened on proper supports and reduced to their minimum values in the track.

For heavy track on nearly level lines and mostly tangent, a stiff 80 lb. rail is about the minimum weight for economy, while with lines for heavy gradients a heavier and stiffer section will be more economical.

"Does the quality of the rail improve as the weight increases?" As the weight increases the reduction from the ingot decreases; more heat units are to be dissipated, and for the same grade of metal the heavier section will be of lower quality. As the weight of the section increases, a corresponding increase in the grade of the metal must be made in the ingot under the present rapid method of manufacture.

"What is the safe maximum rolling load for rail of different weights?" A load of which the static and dynamic effects does not stress the metal over one-half of its elastic limits. While this is high the duration of the intensity of the stress under a wheel load is very short, something under ·02 of a second in 5in. 80 lb. rails for a speed of forty miles per hour, the track being in good condition. Higher stresses than those above stated do occur under a few trains a day, which in a few years leads to the checking of the rails and final fracture of some of the rails in cold weather; the rails being more or less under tension from the falling temperature. The actual fibre stresses in rails are higher than we generally suppose. Many years ago, before as high standards of tracks were maintained as now, the stresses often exceeded the elastic limits of the rails, and permanent set took place.

The past season, I found, from determinations of the stresses by measuring the elongation and compression of the rails under moving trains, apparent stress of 45,000 lb. to 50,000 lb. stress per square inch for the extreme fibres in the base of 4½in. rails. The compression was over one-third of those amounts. On 5in. 80 lb. rails I found the apparent stresses 25,000 lb. to 30,300 lb. under front driver, on rough rails and at speed of thirty-five to forty miles per hour. The combined static and dynamic effects were double at thirty-five miles per hour on the rough rails over the static effects of drivers when standing still. This is much in excess of what it is on smooth rails. On the 100 lb. 6in. rails the stresses are much smaller. No formula has yet been proposed which gives anything like the actual stresses in rails under moving trains. There is the deflection of the rails, the compression of wood of the tie, the deflection of the tie, the compression of the ballast and that of the road, the smoothness of the rail, and tires, and the speed. Then there is the wheel, and tie spacing. It is a very complicated question. I am attacking it by actual tests, but a great mass of data must be collected and analysed before even general results can be stated.—*Railroad Gazette.*

## LEGAL INTELLIGENCE.

### HIGH COURT OF JUSTICE, CHANCERY DIVISION.

(*Before* Mr. Justice Kekewich.)

THE MICA INSULATOR COMPANY *v.* THE ELECTRICAL COMPANY, LIMITED.

This infringement case was heard on June 24th and the three following days. The plaintiffs were the assignees, and sued as the assignees of a patent granted to Mr. Dyer for a material known as "micanite." The patent is dated June 2nd, 1892, No. 10,524. The invention consists of a built-up insulating plate formed of a series of scales of non-comminuted mica held together with cement, their edges overlapping. Plates are subsequently built up of the sheets thus formed till the required thickness is reached. The advantage gained is that very small and otherwise worthless fragments of mica can be used, and so micanite is very cheap. The defence was that the material was not new, the process being old. Counsel for the plaintiffs, Mr. Moulton, Q.C., Mr. C. E. E. Jenkins, Q.C., and Mr. Ward Coldridge, instructed by Messrs. Bennett and Co. Counsel for the defendants, Mr. T. Terrell, Q.C. and Mr. A. J. Walter, instructed by Messrs. Michael Abrahams and Co. Judgment was given on the 30th ult.

Mr. Justice Kekewich: My judgment in this case may be expressed in a few words, few I mean relatively to the importance of the case to the parties and to the time which it has occupied. It is an undoubted fact that micanite is popularly an invention, and an invention of great merit and great utility—the evidence has shown that clearly. But the question which I have to decide is: Whether it is an invention in this sense, that on the 2nd June, 1892, it could properly be protected by letters patent. That is the issue which I have to decide, and the only issue. On many grounds, of which I will mention only a few, I think that that question must necessarily be answered in the negative.

I must say a little about Wood's patent of the previous day, that is to say, of June 1st, 1892. Though the case as regards that stands in an anomalous position, I may venture to say, and certainly in a novel position, I am unable myself to see any substantial distinction between Wood's patent and Dyer's patent; that is to say, reading the specification, as I am entitled to do, as an educated Englishman, and using such explanations as I have had from scientific gentlemen and construing it where it is necessary, although it is not expressed in precisely the same words, it seems to me that the language is so similar, that unless I had scientific explanation to the contrary, I should be bound to assume that each inventor, or each patentee, was aiming at the same result and desired to express the same result.

Wood's specification says: "My invention relates to an insulating material for electric conductors"—they are starting from precisely the same basis, because Dyer says: "My invention relates to means for insulating electrical conductors;" they both take mica, they both take thin mica, and they both take several layers of this thin mica. The difference between the smallest thinness possible and elementary scales seems to me, even without scientific evidence and still more with it, to be, I will not say infinitesimal, but non-existing. They both take care to exclude from their invention or from the process which produces the manufactured article what is called comminuted mica—that they both disclaim. There may be a question whether Wood thought much of irregularly-shaped sheets, but he certainly contemplated the use of them. Mr. Moulton in his summing-up has dwelt upon that as if the irregularity of shape was of importance in Dyer's patent. We find irregularity referred to in Wood's patent, and, even were it not so, the difference between regular and irregular could not to my mind make any difference; but, as a matter of fact, Wood's does contemplate irregular sheets, and he said so in plain terms. Then, they both propose to overlap the edges, and that term has been relied upon as if that were of some importance. I have the specification before me, and Wood, in the sixth line of page 2, uses the words, "overlapping edges." Then it is said that Wood did not contemplate moulding; it is not exactly urged that he did not contemplate bending, but that he did not contemplate moulding. Now, supposing he did not, I cannot myself see that it makes any difference; the invention was the production of a particular article. The use of the article when produced was not the invention; and it may be that neither patentee saw, and probably neither patentee did see, all the many great advantages which the manufactured article would give. But Wood does contemplate moulding, or at any rate bending or pressing, quite as much as Dyer does. Dyer is not explicit as regards what he calls "curving;" he only introduces it, by the way, between lines thirty and thirty-five on page 2 of his specification. On the other hand, Wood, though he does not say that you are to bend it or press it, does say distinctly on the top of page 2 that what had been used before was unfit for certain applications on account of its tendency to fracture on bending, pressing, &c. So that he had before him distinctly as an object to be accomplished the production of an article which would not tend to fracture on bending, pressing, &c., in other words, which would bend or press better than others.

So, without going further, it seems to me that, subject to one remark now to be made, the two specifications run on parallel lines. Where they differ is this: No doubt Wood contemplated the use of some fibrous material, tissue or tissue paper or some other fibrous material, either putting it on both sides, or in certain cases making layers of the fibrous material in between the mica, interleaved it so to speak. He does say so, and there is no doubt that that is what he intended. He says on page 5, "My invention consists of small irregular sheets," and then, having described that which I will come back to in a moment, he says: "Further, in order to make such a sheet composed of thin layers of irregular pieces of mica fastened flatly together, I face on one or both sides, or in between the intervening layers of mica, with a thin fibrous material." And in his first claim and second claim—I will not dwell upon those to criticise them—he refers to the fibrous material. It is obvious that he did not see that the mica built up in the way which he proposed, small irregular sheets with shellac, would do well enough to answer many useful purposes without the addition of the fibrous material. He intended that the fibrous material should be added in order to attain the objects which he thought might be attained; but I think it is going far too far to say that that is the essence of the invention. In Claim 3, where he gives us a very full description of what he desires to produce, the claim is quite complete without the addition, though no doubt he adds it, and that is not to be passed without observation. He does add "fibrous sheets cemented to one or both sides of the micaceous sheet thus formed." I now turn back to lines five to eight, and I observe that Wood never contemplated the fibrous material as necessary in order to fasten the mica together; he saw that he would have his irregular sheets of mica. If they were thin and were properly cemented with shellac, he would have a complete sheet, without the fibrous material. The fibrous material was only an addition to attain the objects, as I say, which he probably thought could not be attained without it. He says: "My invention consists of small irregular sheets and layers of thin non-comminuted mica with overlapping edges fastened flatly together by means of a suitable adhesive material such as shellac." That is the pith and marrow, to use a common expression, of the invention, if it be an invention; the addition of the fibrous material is only an addition, and does not touch the pith and marrow I have already described.

In my judgment, therefore, if you take Dyer's specification as being the same, without the addition of the fibrous material, which is a fair way of putting it in favour of the plaintiffs, still Dyer's is, only as regards Wood's, really the pith and marrow of Wood's without the addition which Wood thought was necessary, but which experience has proved to be unnecessary.

Therefore, if I could regard Wood's as a prior grant, I should have no doubt myself in upholding the plea that Dyer's patent is bad by reason of that prior grant, but then the answer to that is, it is not a good prior grant, because you can only plead by way of prior grant one that is valid, and Wood's is invalid, and there comes the peculiar position. The plaintiffs, when Wood's patent is pleaded as against them as a prior grant, reply, "But it is not a prior grant because it was invalid; it was anticipated by Scott and Thompson;" and that is admitted. The defendants by their rejoinder say they agree to that. The result is that Wood's is out of the way entirely as an invalid prior grant. It cannot be pleaded as a prior grant in opposition to Dyer. Then if the remarks which I have hitherto made are well founded, the result is that Dyer is anticipated, and admittedly anticipated by Scott and Thompson. I do not myself see any way out of it, but, of course, if my criticism of Wood's patent is altogether wrong, then it may be, not necessarily, but it may be that Scott and Thompson are not anticipations of Dyer. If my criticism is well founded, then it seems to me to follow axiomatically that Scott and Thompson are each of them an anticipation of Dyer as well as of Wood. I have plenty of scientific evidence on which I might go into the fact that independently of Wood, Scott and Thompson are anticipations of Dyer. But I do not propose to go into that. Then passing entirely to a different point, the defendants have, in their amended particulars of objection, pleaded many anticipations by prior user. They have only given evidence of a certain number. Of course they have limited their case to what they thought sufficient. Now, as against that I have a certain amount of rebutting evidence, and Mr. Moulton has not failed to make the most of that, and to show, to some extent, a conflict. I propose to deal with that in this very brief way: Strike out everything about which there is a conflict on this point which is not corroborated by Professor Thompson. Professor Thompson spoke in the witness-box of his own experience and observation. As regards any matter of opinion, of course, though his opinion is entitled to great weight, it might be weighed against other opinions, but as regards his own observation of what he saw, there can be no doubt at all. Not only was there no attempt really to break it down, but it stands, of course, as the evidence a of gentleman quite capable of observing, and of course he gave his evidence in the most direct manner. I followed the evidence of the other witnesses and I followed Mr. Moulton's criticism, including his own rebutting evidence. I repeat, strike out everything that can be in contest—I am not saying that that is the proper way of dealing with it on the weight of evidence, but strike out everything about which there is a conflict, and which is not corroborated by Professor Thompson; retain that which stands corroborated by his own observation, and there is quite enough for prior user again and again as against the plaintiffs.

I do not propose to go into it in detail, because that is a matter that would take a long time, and would I think be a useless expenditure of time.

On these two grounds, without saying any more, I hold that the plaintiffs' case fails.

I have ticked off those particulars which I think I ought to be allowed as reasonable and proper, and I will hand the list to the Registrar, but perhaps the easiest way to get it on the notes is to say, as I have found it useful to say on other occasions, those which will not be certified as reasonable and proper. Under paragraph I B "c," "e," "f," and "h." Then "C" "D" and "F."

Mr. Terrell: "f" was proved. That was Wiggins's sheet.

Mr. Justice Kekewich: There is a doubt about it. I do not say it is proved, but I think it is reasonable and proper. Strike out "f," "F" comes out.

Mr. Terrell: "E" stands.

Mr. Justice Kekewich: Yes. "F" goes out; and then under "G" three go out. "a" stands, but "b," "c," and "d" come out. With those exceptions I certify the objections are reasonable and proper, and the plaintiffs must pay the costs of the action.

Mr. Jenkins: Does your Lordship give them Wood?

Mr. Justice Kekewich: Certainly.

Mr. Jenkins: We got judgment on it.

Mr. Justice Kekewich: Then you do not understand what I said.

Royal Institution.—A general monthly meeting of the members of the Royal Institution was held on the 4th inst., Sir James Crichton-Browne, M.D., F.R.S., treasurer and vice-president, presiding. The special thanks of the members were returned for the following donations to the fund for the promotion of experimental research at low temperatures:—Sir Frederick Abel, Bart., K.C.B., £100; Sir Andrew Noble, K.C.B., £100; Sir John Brunner, Bart., M.P., £50.

## ELECTRICAL ENGINEERS' SPECIFICATIONS.*

By J. ALEC. MCLAREN.

THIS subject is one which covers a great deal of ground, and with the limited time at our disposal we cannot pretend to go thoroughly into the matter, or even mention all the items contained in the specification of an electrical engineer, but will just touch here and there on some of the most interesting features. Electricians are a long, long way from the time that they often look forward to and sometimes talk about, when they will be able to dispense with the services of the mechanical engineer, and if you open one of their specifications, you will at once notice that by far the largest part is devoted to the mechanical side of the subject, and only a comparatively small space is taken up by the purely electrical section. Properly speaking, the correct title for this paper should have been the "Mechanical Section of Borough Electrical Engineers' Specifications." I have inserted the word "borough" advisedly, as it is the borough electrician who produces the thickest specifications. There is a considerable difference in the position of a borough electrical engineer and the man who looks after the interests of a company. The former individual is one who is hopelessly bound round with red tape; he is answerable for all his doings to a committee, which at the best is only possessed of that dangerous thing, "a little knowledge," whose members very often adorn such professions as publicans and butchers, and occasionally none at all. A committee such as this, which does not know the difference between a cable and its insulation, but thinks it does, is necessarily an awkward one to deal with, and the omission on the part of an engineer of steam traps or oil filters is as great a sin in its eyes as though he had forgotten to stipulate that the engine should govern well. On the other hand, the engineer to a private company is a man possessed of power; his word is law as long as he produces a good dividend along with the electricity, and if he likes he can practically dispense with such unprofitable things as specifications.

When a Corporation decides to go in for electricity, the first thing to be done is to call in the services of an electrician. They have two ways of doing this. First, by inviting the services of one of our well-known consulting engineers, who will take charge of the whole affair, and afterwards recommend a man to run the station when it is completed. Secondly, by advertising for a borough electrical engineer, who shall conceive the system, lay out the station, and afterwards remain as engineer.

When the man is a capable one, the second method is best, as he knows all the "ins and outs" of the undertaking, is on the spot to see that everything is right to begin with, and does his very best to keep a constant light at an even voltage, and to make the concern pay. His reputation is at stake, his work is watched by all his contemporaries, and if his labour is rewarded by success, he will quickly have earned for himself a reputation in the electrical world that will stand him in good stead when he wants to get a little nearer the top of the tree, where, it is said, "there is so much more room." Whereas in the first case, when the borough engineer has been placed by the consulting engineer after the work has been done, he takes office with no responsibility as to the suitability of the system or the quality of the work, and whenever anything goes wrong he appears before his committee with a light heart, and an infallible excuse that this mishap would never have happened if the concern had only been properly designed.

When the applicant, having satisfied the Council with his credentials, and brought all the influence he can command to his aid, receives the post, the first thing to be done is to decide which is the best system of lighting for the particular town, then to get at the amount of money necessary, which is easily enough got, for all he has to do is to write to a few engineers, boilermakers, and electricians, for quotations for certain sizes of machinery and quantities of materials, which he will get by return of post, and also unsolicited visits from members of the firms in the course of the next few days. Then having recommended to his committee that a certain sum is necessary, he gets instructions to get out specifications and ask for tenders, and now is the time to make himself famous.

His one object is to make his specification as voluminous as possible, so as to impress his wondering committee. He invariably succeeds in this, and produces a book of about 80 pages foolscap size, well bound, the charge of which varies from 21s. to 63s., which is returned on receipt of a *bonâ fide* tender.

In filling this book he is ably assisted by the Town Clerk, and between them they draw up a number of wordy clauses numbering sometimes as many as 44, setting forth the conditions under which the contractor must work. I cannot pretend to go through these clauses to-night, or there would be no time left for anything else. But I will say that these clauses, which are so manifestly one-sided, so carefully worded, which go to protect the Corporation against every conceivable contingency, the wonder is that any firm agrees to be bound by them. When a contractor signs his name to be bound by these conditions, he practically gives up all liberty, and leaves himself entirely at the mercy of the borough engineer, as the following clause will show:—"The works generally, and every part thereof, shall be executed and completed, and the provisions of the specification complied with to the satisfaction of the engineer, and in all cases of difference of opinion as to the manner in which the works are executed, or as to the quality of the materials, or as to the true intent and meaning of this specification, or the said drawings, or as to the matter of charge, on account or otherwise, as between the Corporation and the contractor, either during the progress or after the completion of the works, the decision of the engineer shall be final and binding on both parties." On looking through these famous clauses one would think that it would be by the purest accident that the contractor got paid at all, and it would only be by good luck that he escaped paying the Corporation some indemnity. As a matter of fact, familiarity in this case brings its usual result, and these clauses are generally just taken as read, and are referred to as "clauses of the usual significance." The only ones a tenderer spends any time over are those relating to "time of delivery," "penalties," and more especially to "terms of payment."

*Penalties.*—There is usually a penalty put against bad delivery, but as a rule it is not abnormal. A curious fact in connection with penalties is that, according to law, the payment of a penalty cannot be enforced unless it is claimed as ascertained liquidated damages; in the later specifications it is put in this form. It is very often stated that if the plant uses any more steam than a certain amount per kilowatt or per indicated horse-power that a penalty of so much per pound will be enforced. As a set-off against this the purchasers appear to be very generous by offering the contractor a bonus for every pound of steam under that figure, but take care to make it so low that there is no chance of any bonus changing hands. For instance, the Yorkshire House-to-House Company offered a bonus of "£200 per pound, or *pro rata* for every complete tenth part of a pound, for every pound or part of a pound under 14½ lb. per indicated horse-power." That was for a compound engine running at 100 revolutions, 125 lb. pressure, and the water was measured into the boiler. In short, they put the amount of steam at such a low figure that the contractor will be lucky if he reaches it, and stick on a penalty for anything above it, and a bonus for anything below it, so that here again the manufacturer has everything to lose and nothing to gain.

*Terms of payment.*—This is a clause that is always examined, and it often requires to be done carefully. It does not do to be in a hurry when you want to know how you are going to be paid. For example, Derby Corporation tells you in this manner, "Clause 37, that subject to the conditions herein contained, the contractor shall be entitled to payment for his work in manner following, that is to say, to a monthly instalment equal to 80 per cent. of the *primâ facie* value, as far as the same may then be ascertained, of the amount of work executed in the then preceding month, to a future instalment of 10 per cent. of the *primâ facie* value, as far as the same may then be ascertained, of the amount executed, when such works have been completed, and delivered to and accepted by the Corporation in manner aforesaid, and to the balance, whatever the same may be found to amount to, so soon as the responsibility of the contractor shall have ceased and been determined. Provided no sum or sums of money shall be considered and owing, nor shall the contractor make or enforce any demand upon or against the Corporation for or on account of any work executed by him, unless the contractor shall have delivered from time to time, and at all times within one week from the expiration of the month in which the amount of work then claimed for shall have been performed, a true and proper claim, or true and proper claims, nor unless the engineer shall have certified or recommended the amount to be paid, as such instalment or balance to the contractor, and that the contractor is reasonably entitled to such instalment or balance respectively, nor unless such certificate shall have been presented to the Town Clerk; nor shall any such sum or sums of money be considered payable to the contractor unless the expiration of fourteen days after such certificate shall have been so presented; nor shall any omission to pay the amount of such certificate at the time the same be payable be held, or deemed to vitiate, or avoid, or in any way affect the contract; but in such case the contractor shall be entitled by way of compensation to interest thereon, at and after the rate of £5 per cent. per annum, for such time as such omissions shall continue. Provided always that with respect to all admitted and adjusted claims made in pursuance of the fifth section of this specification, the contractor shall be entitled to be paid in full, and with respect to any disputed or unadjusted claim or claims made, or alleged to be made, in pursuance of such section, or otherwise the contractor shall not be entitled before the final settlement of the contract, to any payment on account or otherwise, unless and until the engineer shall certify the correct amount of such claim or claims; nor unless and until the contractor shall give a receipt in full for and in respect of any monies paid to him in discharge thereof. And provided also, but subject as lastly mentioned, that for the greater convenience of the parties it shall be competent to the engineer to give the contractor recommendations for payment on general account in anticipation of any *primâ facie* or final certificate, or of any award, as the case may be, and to the Corporation or duly authorised agent to make to the contractor any payments on general account, either in pursuance or in anticipation of such recommendations or otherwise, and to set off the same; and provided further that no certificate or recommendation, nor any payment on general account, shall be taken to be an admission of the due performance of the contract, or of any part thereof, or of the accuracy of any claim or demand made by the contractor, nor shall any such certificate, recommendation, or payment, conclude or prejudice the powers of the engineer or the settlement of the contract, and the determination of the sum or sums, or balance of money to be paid to or received from the contractors; nor in any other way vary or affect the contract entered into by the contractor." Contrast that with the manner in which the engineer for a company puts it, viz., "80 per cent. when the whole of the stuff is delivered on ground, we to keep 20 per cent. in hand, until the end of three months, after the engine has been tested to our satisfaction." Comment is superfluous.

*Cost of tendering and manufacture.*—The cost of tendering for electrical work is considerable, and sometimes out of all proportion to its value. One of our largest electrical firms spent £200 in tendering for the work in connection with a new station, and they did not get the order. Another well-known firm of engine makers tendered 215 times with an electrical establishment without obtaining an order; I hope they will get one before the 300 is up. One engineer in beginning a station asked for no fewer than thirty-seven drawings of parts of the installation. Seeing that for every tender advertised there will be at least six firms competing, there is a great deal of wasted work when they all have to produce so many drawings. Another source of expense is that the drawings must often be drawn to a certain specified scale, which is quite unnecessary. In one case I remember the arrangement plan had to be drawn to a scale of $\frac{1}{16}$in. to a foot, the other ones to $\frac{3}{32}$in. or 1$\frac{1}{2}$in. to a foot. The borough engineer, when asked if it was absolutely necessary to draw them out to these scales, said, "Oh, not all; they were that way in the original specification, and I just copied it out again." He did not realise the time and expense in changing complicated drawings from one scale to another. Then it is quite customary to ask for a complete set of prints of every detail in the contract, occasionally in duplicate, and must be signed by the engineer before work is proceeded with, but although he signs them he carefully states that by so doing he takes no responsibility for the correctness of the work. These men abhor responsibility. It does not seem to be the right thing, from the manufacturer's point of view, that he should scatter all over the country detail working drawings of his machinery that has been designed at great cost, and is the outcome of much experience, but it is done every day. Another request which is not liked in the drawing-office is the demand for foundation arrangements a few days after the order is given out. The consequence is that in the case of new designs which occur very often you have to plant the foundation bolts and trenches and afterwards make the engines to suit. I don't see the absolute necessity for foundation arrangements before the engine-house is built. In order to show the difference between electricians and ordinary beings I give this case. In one of the towns on the North-East Coast a firm of shipbuilders turn out annually about ten large steamers, which cost approximately £29,500 each, when the engines are included. That firm, I know for a fact, does not spend £5 per annum in the drawing-office for tenders! Well, in the same town a few months ago the Corporation advertised in all the leading engineering papers that "they were prepared to receive tenders for one steam feed pump." Specifications and forms of tender could be obtained from the borough electrical engineer by paying a deposit of 21s. Tenders must be in not later than twelve o'clock noon on a certain date.

*Cost of manufacture* of the engines is also higher for electrical work, which will be explained when we come to that part of the subject. Another item which runs the price up is the testing they have to go through. The boilers have to pass an evaporation test. The engines and dynamos have to be tested all round; the feed pumps, and condensing apparatus likewise are subject to a similar examination. The following clause relating to tests is taken from a specification: "Each engine, alternator, and exciter to be erected and coupled together and run continuously for twelve hours, viz., four hours at full load, four hours at three-quarter load, and four hours at half load, at the maker's works, in the presence and to the satisfaction of the engineer. The steam consumption will be taken at each of the above loads, and the average consumption of water per kilowatt hour, measured at the terminals of the alternator, not to exceed 32 lb. for double-compound, and 28 lb. for triple-compound plants. The tests specified herein for temperature, conductivity, &c., will also be made. Independently of the above tests, each engine will be exhaustively tested on the brake, at full load for twelve hours. These tests will be repeated after erection at the central station, together with any other the engineer may deem necessary." Now, it is all very well to test an engine, but it can be overdone; and in such instances as this the cost of testing comes to a considerable percentage of the total value of the engine, especially when it is a small one. This point is often entirely ignored by the electrician, who will coolly turn round and tell you that he could buy a marine engine of equal power at a much lower figure. When an engine has to be tested on the brake for efficiency, it is no use taking the first day's figures, or even the first week's, that is, if an efficiency of 90 per cent. is guaranteed. It is usually found that it takes an engine about three weeks running night and day before it gets up to the mark. Now there is no fault to be found in demanding a brake test; every engine ought to be similarly tested, weak spots are found out and put right, and the engine leaves the shop in a position to take up its full load at once without any trouble. But it has got to be paid for, that wants to be realised more by the purchasers. A plant that has to pass stringent tests must be an economical plant; an economical plant must do its work very easily, so must be a large plant, and as a large plant costs more money than a small plant, therefore an economical one costs more than an uneconomical one. It is safe to say that the price of a first-class plant is 50 per cent. more than one which could be bought to do the same work when economy and efficiency are not considered of much importance, especially in small sized units.

Having now got through the preliminaries, we come to the specification proper, which is divided into sections, and are generally arranged as follows:—(1) Boilers and accessories: (2) pipes: (3) steam alternator: (4) switchboard and meters: (5) underground work; (6) arc lamps. As I have said before, we cannot pretend to discuss all the subjects, and will spend the remaining time on the first three.

*Boilers.*—The class of boilers used differ greatly in their construction; they are usually either Lancashire, Babcock and Willcox, locomotive, or marine, the first two being by far the most general. You can scarcely imagine two boilers so different in their design, yet it is generally a case of either one or the other, and often both are used in the same place. There are many points to be dealt with when settling on the style of steam raisers. In large towns, where ground rent is heavy and the price of land high, efficiency often has to be sacrificed to the keeping down of the annual charges involved. Another important point is the quality of the water used. As every central station is liable to be called upon suddenly to supply abnormally large demands, owing to sudden fogs, &c., it would appear that a boiler which raised steam quickly is a necessity. In the water-tube boiler this faculty is fully developed, and it is often used on account of this quality alone. The Lancashire boiler is often preferred on account of its storage capacity, but to get steam quickly it is necessary to keep a boiler always in reserve under steam, so that the time required to get it in commission is not more than would be wanted with a water-tube boiler when the water is cold. In these two boilers we have the different extremities. Quick steaming, no storage, take up little room, in the one case, and slow steaming, large storage, uses much more space, in the other case. A compromise of these qualities is found in a locomotive boiler. Boiling water in bulk, as in the Lancashire boiler, cannot be economical, especially under varying loads. The tubular boiler splits up the water, gives better heating surface, so must be more economical, but its small space available for water renders it more dangerous, and should the feed-water be stopped no time is available to put matters right, and often the fires have to be drawn.

Whereas, in the locomotive type we have a quick steam raiser, a fair storage capacity, and use comparatively little space, while another advantage is that no brickwork or setting is wanted, so that, everything else being equal, it seems to fulfil most nearly the conditions required. The question of maintenance and repairs requires some consideration. In the Lancashire boiler the deterioration is fairly even, but it must not be forced. The great difference in expansion when a big fire is lit to raise steam quickly before the large mass of water is heated must do damage to the boiler, and it only requires this practice to be repeated often enough to cause disaster. In the Babcock and Willcox type the greatest trouble is a failure of the tubes owing to scaling. The caps on the sections opposite the tubes are dependent entirely on the thread of a screw to keep them in position, this piece of design if often objected to by the engineers. The weak part of a locomotive boiler is undoubtedly the fire-box, but when the water is good and the box is made of copper, it has a long life and makes steam very comfortably. The marine boiler as yet is not largely used; it may be described as a very good generator in a very bad shape, and as space is not of so much importance ashore as on board ship it is not likely that this boiler, with its large diameter and great extent of flat surface, necessitating very thick plates and a great amount of staying, will become general when other kinds can do the same duty with much less weight of material at a reduced first cost.

*(To be continued.)*

* Read before the Yorkshire College Engineering Society, January 31st, 1898.

## REFUSE DESTRUCTORS AND ELECTRIC LIGHTING IN BERMONDSEY.

THE Vestry of Bermondsey resolved on Monday, in the event of the passing of the Bill confirming the Vestry's electric lighting Provisional Order, to erect a refuse destructor in conjunction with the proposed electric lighting station, in accordance with a lengthy report submitted at that meeting by Messrs. Kincaid, Waller, and Manville, the consulting engineers to the Vestry. The report refers initially to having reconsidered the question of a refuse destructor, and that it now appears the cost of disposing of the ash-bin refuse is as much as 1s. 8d. per ton, as compared with 1s. 2d. per ton estimated at the time when the consulting engineers reported unfavourably on the establishment of a destructor in June of last year, owing to the cheap system of disposal. In their opinion, however, if a site in the vincity of the Vestry hall could now be secured for the erection of a combined refuse destructor and electric light station, the heat produced by the combustion of house refuse might be economically utilised for heating the water at the baths and working the machinery used in the baths and wash-houses, with a consequent additional saving that would be effected by the utilisation of this heat for the production of electric power. Having reconsidered the question on this basis, Messrs. Kincaid, Waller, and Manville submitted an estimate of the capital cost of additional works for the erection of a refuse destructor to deal with 11,711 tons of house and trade refuse per annum. This estimate amounts to £10,000, comprising £1000 as additional cost of chimney shaft, £8000 for six destructor cells, with extra cost of containing buildings, inclined roadway and motor fans for forced draught, and £1000 for contingencies and clerk of works. The annual maintenance is put at $\frac{2}{3}$s. $\frac{5}{10}$d. per ton of refuse, or a total of £1359, and the saving and revenue at £1170 per annum. The final financial statement is then set forth as follows:

| | £ | £ |
|---|---|---|
| Annual maintenance .. .. .. .. .. .. .. .. .. | 1359 | |
| Revenue and saving .. .. .. .. .. .. .. .. .. | 1170 | |
| | | 189 |
| Present cost of disposing of 11,711 tons of house and trade refuse at 1s. 8d. per ton .. .. .. .. .. | | 975 |
| Estimated net saving .. .. .. .. .. .. .. .. .. | | 786 |

Quoting now from the report, the consulting engineers say:—"In the estimate of annual maintenance, we have taken the labour and superintendence on the basis of the destructor only being run six days in the week in place of seven, enabling you to work two shifts a day only. We have taken the cost of the removal of the clinker at 1s. 10d. per ton of clinker removed. (In this figure we do not quite agree with the surveyor, Mr. Sumner, who has estimated the cost of this, including both carting and tipping at 2s. 8d. per ton). From our actual experience at Shoreditch, however, where the cost of removing clinker must be at least as great as in any other part of London, and where only 1s. 10d. per ton is paid for this service, which amount, it is hoped, will be reduced in the immediate future, we have no hesitation in expressing an opinion that you will be able to dispose of such of your clinker as you require to have removed, for no greater charge than this. The amount of clinker is arrived at on the assumption that only 25 per cent. of the refuse burnt will be produced as clinker. At Shoreditch the percentage of clinker is about 30 per cent. but there

can be little doubt that the refuse at Bermondsey is richer in combustible material than at Shoreditch, and we have therefore taken 25 per cent. as the residue. Of this 25 per cent., it is estimated by Mr. Sumner that one-third can be utilised for the purposes of the parish. We therefore believe that this inclusive estimate of maintenance for the burning of refuse, amounting to about 2s. 4d. per ton, is one that can be worked to in practice.

The saving and revenue per annum takes the credit for the steam which may be utilised for the baths heating purposes, and also supplying power there which at present consumes coal to the value of £431 19s. per annum. We have allowed in this estimate, as a debit to this item, the interest and sinking fund on £1000, which sum, it might be wise to spend in providing apparatus to enable the baths to be heated by the utilisation of the exhaust steam from the electric light engines in place of using live steam from the boilers for this purpose ; for you must bear in mind that for all heating purposes where the water is not required to be raised above boiling temperature, exhaust steam is practically as useful as live steam, leaving only live steam to be used for the actual boiling in the washing troughs. Credit is taken for one-third of the clinker produced at 2s. per ton. This price, Mr. Sumner estimates, it will be worth for other parish purposes. There is a credit for 2180 tons of combustible trade refuse which we have taken at 2s. 6d. per ton, but which is included in Mr. Sumner's figures at only 1s. 8d. per ton. Here again we feel sure from our experience at Shoreditch, that at least 2s. 6d. can be obtained for the burning of trade refuse on the average.

Then comes the estimate of coal saved in the electric-generating station, which is calculated on the basis of the destructor running only six days per week, coal being used on Sundays. We have no hesitation in stating definitely that the 11,000 tons of refuse you have to burn will produce all the power required for the plant you are proposing to put down in the first instance in your electric lighting station, as the proportional amount of power produced at Shoreditch per ton of refuse is greater than this, notwithstanding that probably their refuse has a smaller calorific value than that at Bermondsey.

Finally, you must bear in mind that during a great portion of the day the live steam produced by the dust destructor will not be utilised, as the electric-generating station will then be producing but a small output, unless a day load is found in the shape of a supply of current for motive power purposes.

The financial statement shows you that under these estimates a net saving of £786 15s. 4d. per annum will probably be made on the combination of a dust destructor with the electric-generating station and baths, which is so considerable an amount as to cover all contingencies and still leave a certainty of a considerable annual saving being made ; whilst on the other hand you will be sure that the price of disposing of the refuse will remain a constant quantity year by year, delivering you from all doubt as to the cost of its disposal by any other methods, increasing as it very probably might do."

## IRON AND STEEL INSTITUTE.

IN accordance with previous announcements, the autumn meeting of the Iron and Steel Institute will be held at Stockholm on Friday and Saturday, August 26th and 27th next. The following papers have been promised for reading :—(1) "On the Development of the Swedish Iron Industry," by Richard Akerman, Director-General of the Swedish Board of Trade, Honorary Member and Bessemer Gold Medallist. (2) "On the most Prominent and Characteristic Features of Swedish Iron Ore Mining," by Professor G. Nordenström, School of Mines, Stockholm. (3) "On the Danger of using too Hard Rails," by C. P. Sandberg, M. Inst. C.E. (4) "On the Action of Explosives on the Tubes of Steel Guns," by Professor W. C. Roberts-Austen, C.B., D.C.L., F.R.S., Vice-President. (5) "On Brittleness in Steel, produced by Annealing," by Mr. J. E. Stead, F.I.C., Member of Council, Middlesbrough. (6) "On the Micro-Chemistry of Cementation," by Professor J. O. Arnold, University College, Sheffield. (7) "On the Influence of Metalloids on Cast Iron," by Guy R. Johnson, Embreville, Tennessee, U.S.A. Members who intend to take part in the discussions will, on notifying such intention to the Secretary, have copies of the papers forwarded to them in advance.

The programme of the meeting is as follows :—

*Wednesday, August 17th.*—The s.y. Argonaut, 324 tons and 4000-horse power, specially furnished by Dr. H. S. Lunn to convey the members to Sweden, and to serve as a floating hotel, will leave Newcastle at 6 p.m. The vessel will call at Kiel and Copenhagen, and will lie at Stockholm during the meeting, taking Wisby, Gothenburg, and Christiania on the return journey. The Orient Steam Navigation Company's s.s. Lusitania will leave London the same day on a pleasure cruise to the Baltic, and will also lie at Stockholm during the meeting.

*Thursday, August 25th.*—The s.y. Argonaut will arrive at Stockholm in the morning. In the evening there will be a reception and conversazione by the Local Reception Committee, at the Jernkontorets building. To this ladies will be invited.

*Friday, August 26th.*—In the morning the members will be received by Baron G. Tamm, President of Jernkontoret and Governor-General of Stockholm, President of the Reception Committee ; by Mr. R. Akerman, Chairman of the Executive Committee ; by Mr. J. C. Kjellberg, Honorary Secretary ; and by the Members of the Local Reception Committee. Immediately afterwards the general meeting will be held, and a selection of papers will be read and discussed. At 7 p.m. there will be, by kind invitation of Jernkontoret, a banquet at Hasselbacken. Ladies will not be invited.

*Saturday, August 27th* —The general meeting of the members will be continued, and a selection of papers read and discussed. It is hoped that in the evening H.M. the King of Sweden and Norway will graciously consent to receive the members at one of the Royal Palaces. Ladies will not be invited.

*Sunday, August 28th.*—In the evening the s.y. Argonaut will leave Stockholm, and one hundred of the members, who, in reply to the circular of March 17th, expressed a desire to receive invitations to visit works, will leave in two special trains. The fifty members comprising Group A will visit Grängesberg Iron Mine ; the Ironworks of Domnarfvet, belonging to the Stora Kopparberg Company, the Ironworks of Hofors, of Sandviken, and of Forsbacka ; the Falun Copper Mine ; Dannemora Iron Mine, and Skutskar Saw Mills. The fifty members comprising Group B will visit Laxa Iron and Cellulose Works, Degerfors Ironworks, Bofors Ironworks and Ordnance Factory, Nykroppa (Storfors) Ironworks, Persberg Iron Mine, and the Uddeholm Iron and Cellulose Works. Ladies and the members not taking part in these excursions will proceed in the s.y. Argonaut to Gothenburg, calling at Wisby, a town of the highest historical and antiquarian interest, and of great natural beauty. At Gothenburg they will be re-joined on Thursday, September 1st, by the members returning from the excursions to works.

*Friday, September 2nd.*—The s.y. Argonaut will arrive at Christiania.

*Monday, September 5th.*—The s.y. Argonaut will arrive at Newcastle.

A fortnight before the meeting in Stockholm a limited number of members will, by kind invitation of the Gellivare Mining Company, visit the mines of Gellivare, Luossavaara, and Kiirunavaara, within the Arctic Circle. In view of the difficulty of securing suitable hotel accommodation and sleeping cars on the railways for a large number, a sea route to Stockholm will be found most convenient. At Stockholm the s.y. Argonaut will lie in close proximity to the Grand Hotel and the Opera House.

Members proceeding to Sweden by the Overland Route will have the privilege of travelling to and from Stockholm on the State Railways at half the ordinary price for single tickets. Members who wish to avail themselves of this reduction must apply to the secretary for the requisite tickets. Members are also requested to communicate to the secretary the addresses to which they wish their badges of membership to be sent.

## LAUNCHES AND TRIAL TRIPS.

ON July 1st Messrs. Wm. Simons and Co., Limited, Renfrew, launched, complete, from their yard the Fedor Enrold, being the third of four powerful barge-loading dredgers which they have on order for the Russian Government. This vessel has been constructed under the inspection of and is also classed by Bureau Veritas. Independent steam hoisting gear is provided for manipulating the bucket ladder, and also independent steam winches are fitted at the bow and the stern of vessel for manœuvring when at work. Electric light is fitted on deck and throughout the vessel for working day and night. There are separate cabins for the officers and crew, and private cabin on deck is also provided.

On Saturday, July 2nd, Sir Raylton Dixon and Co., Limited, launched from their Cleveland Dockyards, Middlesbrough, a steel screw steamer, being the second of two built to the order of Mr. Martin Carl, of Copenhagen. Her principal dimensions are 250ft. by 35ft. 6in. by 19ft. moulded. She is built to Lloyd's rules, with special arrangement of loading facilities and continuous hatchways, for a deadweight capacity of about 2000 tons on a light draught of water. Triple-expansion engines will be fitted by Messrs. George Clarke, Limited, Sunderland, having cylinders 18in., 29in., and 48in., by 33in. stroke, with one large boiler working at 160 lb. pressure. The vessel has been constructed under the personal supervision of Captain Knudsen. On leaving the ways she was named Therese, by Miss Laura Caspar, of Linthorpe.

On June 27th the s.s. Bellerby, built by Messrs. Ropner and Son, of Stockton-on-Tees, to the order of Messrs. R. Ropner and Company, West Hartlepool, made her official trial trip in the Tees Bay, which was highly satisfactory to both her owners and builders. This steamer has been built under the trunk patent, and has full poop, bridge, and topgallant forecastle. The saloon and cabins for captain and officers are fitted in the poop, with accommodation for engineers and apprentices in houses on the bridge deck, the crew being berthed in the forecastle as usual. The steamer will carry about 4600 tons on Lloyd's summer freeboard, on a light draught, and has all the most recent appliances for the expeditious loading and unloading of cargoes, her outfit and equipment generally being quite up to date. The steamer is fitted with a set of powerful triple-expansion engines by Messrs. Blair and Co., the well-known engineers. After a successful run, when the machinery gave out the best results, the vessel made for the Tyne, where she will load for Genoa. The owners were well represented by their marine superintendents, whilst Mr. Leonard Ropner represented the builders.

On Monday, July 4th, the fine steel screw steamer Elna, built by Sir Raylton Dixon and Co., Limited, Cleveland Dockyards, Middlesbrough, to the order of Mr. Martin Carl, of Copenhagen, was taken out to sea for her official trials under the command of Captain J. Möller. Her principal dimensions are 250ft. by 35ft. 6in. by 19ft. moulded. She is built to Lloyd's highest class, single-deck rule, having poop, bridge, and forecastle, and a deadweight capacity of about 2000 tons on a light draught of water. Triple-expansion engines have been fitted by Messrs. Geo. Clarke, Limited, of Sunderland, having cylinders 18in., 29in., 48in., by 33in. stroke, with one large boiler working at 160 lb. pressure. The vessel has been constructed under the personal supervision of Captain Knudsen, and is a sister vessel to the Therese, which was launched by Sir Raylton Dixon and Co., Limited, on Saturday last. After the trials, which passed off most satisfactorily, the vessel proceeded to Blyth to load for Copenhagen.

On the 30th ult., Messrs. Joseph L. Thompson and Sons, Limited, of the North Sands Shipbuilding Yard, Sunderland, launched the s.s. Moorgate, built to the order of Messrs. The Dowgate Steamship Company, Limited, of London, of which Mr. H. W. Dillon is the managing owner. She is built on the three-deck rules, to Lloyd's highest class, with only one deck laid. Her principal dimensions are : — Length between perpendiculars, 385ft. ; breadth extreme, 45ft. 6in. ; depth moulded, 26ft. 4in. She is designed to have a large cubic and deadweight capacity, which will be carried on a moderate draught of water. The propelling machinery is constructed by Messrs. John Dickinson and Sons, Limited, of Sunderland, the sizes of the cylinders being 23in., 38in., 62in., by 42in. stroke, supplied with steam from two multitubular boilers at 160 lb. pressure. The vessel was named, and launched by hydraulic power, by Miss Harland, daughter of Captain Harland, who will take command of the vessel.

## ENGINEERING NOTES FROM SOUTH AFRICA.

*(From our own Correspondent.)*

THE returns of the Witwatersrand gold output for April, which are just coming to hand as I write, show another considerable increase in the production. On the other hand, the official statistics of the imports of machinery and plant into the Transvaal show a heavy decline upon the totals of a year ago. The two facts to a certain extent explain each other. All the richer mines have completed their capital expenditure upon equipment, and the only mines requiring mechanical installations upon a large scale are those which possess the necessary funds to pay for them. No doubt we should see dozens of financial "reconstructions" for this purpose, were it not for the utter stagnation in Kaffir shares, both in Johannesburg and London.

The mines labour under such disabilities as excessive railway rates, insufficient labour supplies, an illicit drink traffic, a monopoly in dynamite, and unchecked gold thefts. The removal of these evils, or their mitigation, would be the equivalent of an advance of one or two pennyweights per ton in the grades of ore mined. That would mean in its turn the conversion of properties at present "impossible" into properties that could be worked at a profit. It is only natural that capitalists refuse to sink money in development and equipment under present conditions, when so much more can be got for the outlay once these reforms are accomplished. Moreover, it must be remembered that an Industrial Commission of the Boers themselves has recommended the amelioration of every one of the grievances catalogued above. Unfortunately the dominant party at Pretoria is hostile to the mining industry, and stolidly refuses all concessions. Left to itself, this party would yield nothing to the English mining financiers and managers. Race hatred means a good deal for the Boer, while of the most elementary economics he knows nothing. His narrow policy has, however, seriously embarrassed the Republic's finances, and it is probable that before long the Pretoria rulers will have to go to Europe for a loan of several millions. They will then find that the Berlin and Paris houses are at one with the London capitalists in demanding industrial reforms as a condition to advancing money. When that threefold pressure is applied Pretoria may grudgingly give way and grant the Witwatersrand a more or less restricted meed of reform. Until that day British engineers and machinists can only expect a very moderate flow of orders from the Transvaal goldfields.

In the early days of the Rand, locomotive boilers and simple non-condensing engines were considered good enough for all requirements. Since then academic engineers of high repute have been imported, who have almost ignored workable qualities in the search for the highest attainable theoretical efficiency. The result has been a series of breakdowns and complete derangement of the work of production. One such interruption takes a lot of fractional fuel economy per indicated horse-power to make up for the loss involved. The proper type of engine for the continuous running of a heavy stamp battery, with all its enormous strain and vibration, is obviously a mill engine. Some of the more up-to-date consulting engineers, however, have been essaying types of engines which have been built specially for electric lighting work. One can hardly expect an engine running at 350 revolutions to drive a mill uninterruptedly for thirty days without requiring any repair. Yet this is what is required of a battery engine. It is not in the least surprising that fast-running quadruple-expansion electric lighting engines, when applied to battery driving, have proved a continual source of trouble. Experience seems to show that the best possible engine for this class of work is the compound surface-condensing type, of massive but not too complex design.

Most of the mines which have any money to spend are going in for condensing plants, which give valuable results in the shape of fuel economy. Air-compressing plants are being augmented if possible, so as to provide auxiliary power for machine drilling in the event of a scarcity in machine labour. Cyaniding and slimes plants are being continually added to and improved, and there is a great demand for electric motors in connection with this class of work. The Rand Mines, the great "deep level" corporation, has set an excellent example by ordering automatic weighing machines for all the mines under its control. These are intented for exactly ascertaining the weight of ore crushed per stamp per day. As such a system will add greatly to the value of the data upon which the efficiency of mine plants are tested, every paying mine on the Rand is likely to equip itself with such apparatus.

A fine engineering feat has been accomplished during May at the Howard shaft of the Sunnier West mine. No fewer than 183ft. were sunk in the course of the month—a world's record for this class of work. The average sinking at this shaft for past three months has been 137·33ft.

## AMERICAN ENGINEERING NEWS.

*(From our own Correspondent.)*

*Boiler plant of a sugar refinery.*—The four-storey boiler house of the new Arbuckle refinery has twenty-three Babcock and Wilcox water-tube boilers, each rated at 302-horse power, or a total of 6946-horse power, fourteen boilers being on the second floor and nine on the third. They are set in ten batteries of two boilers each and three single boilers. Each boiler contains sixteen sections of tubes, each section being nine tubes high. The tubes are 4in. diameter and 18ft. long. Each boiler has two 42in. drums. There are four economisers on each floor, one for each two batteries of boilers, and the flues are so arranged that the gases from a pair of batteries may be carried either through its economiser or below it in case the economiser should require cleaning or repairs. To each boiler are fitted two under-feed mechanical stokers, operated independently of each other. Each stoker consists of a retort or magazine in the furnace and extending below the grate surface, and connected with a hopper located in front of the boiler by means of a conveyor pipe. In the bottom of this retort a worm is revolved by means of a small self-contained steam motor, which requires only about 0·2-horse power to operate it. The coal which is fed into the hopper is carried by the worm through the conveyor and the retort, up to and spread over the grate surface. The draught for combustion is furnished at a pressure of about 1½ oz. by means of blowers, which are hung in this case from the bottom of the coal bins. The air is admitted to the stoker through tuyere blocks placed on top and around the outer edge of the retort. The rate of feed of the coal and the amount of air used in the furnace are entirely under the control of the firemen. The building is on the river front, and coal from the barges is handled by mechanical means. A steel tower is built close to the wharf, and from it there extends over the water a parabolic trussed beam which is hinged at the tower so that it can be swung out of the way of the mast of a vessel. This beam forms the support for a travelling carrier, from which is suspended a grab bucket operated by a hoisting engine in the tower. The coal, on being hoisted from the boat, is deposited in a hopper in the tower, in which it is automatically weighed by a scale overhead from which the hopper is suspended. From the hopper it passes into a coal-cracking machine, which reduces it to a size suitable for the stokers, and from the cracker it passes through a chute into a filler which loads it into the buckets of a Hunt traveling conveyor. The endless chain of buckets then carries the coal up an inclined plane to the storage bin at the top of the boiler house, depositing it at any desired point in the length of the bin. The feed-water heaters are each 12ft. 6in. long and 5ft. 8in. diameter, with 16in. exhaust steam inlets and outlets, 5in. feed-water inlet and 6in. outlet, and are rated each at 1500-horse power. The feed-water purifiers are 5ft. 8in. diameter and 30ft. 4in. long, and are rated at 1250-horse power. The feed-water enters at six different points on the top of the heater, and is taken out through a 6in. opening in the bottom. The steam is supplied through a 10in. pipe. Both ends of the heater are removable, so that the scale pans may be removed from either end as may be most convenient. In some Babcock and Wilcox boilers, taking forced draught at ⅜in. water pressure under maximum load, the quantity of air supplied is automatically regulated by the steam pressure in the boiler, the fan slowing down as the pressure increases beyond the desired point. The system includes the blower and an engine to drive it, with a regulating valve placed on the steam inlet pipe to the blower engine, so arranged as to open and increase the speed of the fan when the pressure of steam in the boilers falls below the desired point, and to close this valve when the pressure is restored. There is also a pressure reducing valve placed in series with the regulating valve to limit the high speed of the fan and the consequent draught pressure. A by-pass around the regulating valve admits a little steam to the engine when the regulating valve is closed, and gives the fan just enough speed to keep up the combustion and keep the grates cool.

*Marine notes.*—The largest cargo ever carried on the Great Lakes was that of 6823 gross tons of iron ore recently delivered to the Illinois Steel Company by the steamship Superior City. Previous to this the record was 5638 gross tons of corn, carried by the new steamer H. R. Linn.—The new steamer Georgia, built for passenger service on Lake Michigan, is 206ft. long and 34ft. beam, with accommodation for 150ft. passengers and a freight capacity of 800 tons.—Another large steamer for the Great Lakes is the Presque Isle, which was launched in May. It is 426ft. long, 406ft. on the keel, 50ft. beam, and 28ft. deep. It will be driven by quadruple-expansion engines, steam being supplied by two Babcock and Wilcox water-tube boilers. The hull has a steel tank top and a 5½ft. water-ballast tank bottom, extending from the collision bulkhead to the engine-room bulkhead, and divided into three compartments. It will carry 6000 tons of cargo on a draught of 14ft. Its cost was about £40,000.—At a builder's trial of the new revenue cutter Algonquin, on Lake Erie, a speed of 18·4 knots was attained. As the boilers were not fully lagged, the coal was poor, and the full force of firemen was not on board, it is expected to increase the speed to 19 knots. The engine runs at 162 revolutions. The boat will be cut in two and sent down to the Atlantic, for use by the navy as a torpedo boat—The largest wooden steamer in commission on the Great Lakes, if not in the world, is the Thomas Cranage, recently built on Lake Michigan. It is 330ft. long, 43ft. beam, and 26ft. moulded depth, with a minimum depth of hold of 20ft. 6in. It is of Michigan white oak throughout, except the white pine deck planking. At the heads of the frames is a steel strap, ⅜in. by 14in., and on each side is a steel arch, ⅜in. thick and 14in. deep, extending from end to end. There are also diagonal steel straps riveted at their intersections. The tonnage is 2220 gross, or 1856 net, with a displacement of 4000 tons. It will carry 110,000 bushels of wheat on a draught of 16ft. 6in., and 3050 gross tons of iron ore on a draught of 16ft. 8in. The single screw is

driven by a triple-expansion engine, with cylinders 20in., 33in., and 54in. diameter, and 42in. stroke, the engines and boilers being placed well aft, as in many of the Lake freight steamers. A Universal coupling connects the crank shaft with the thrust shaft. There are two Scotch boilers, 14ft. diameter and 12ft. long, carrying a pressure of 160 lb. The bunkers have a capacity for 300 tons of coal. The vessel has a regular sea speed of 13½ knots, and a maximum of 14 knots per hour.

## THE IRON, COAL, AND GENERAL TRADES OF BIRMINGHAM, WOLVERHAMPTON, AND OTHER DISTRICTS.

*(From our own Correspondent.)*

THE importance which continues to attach to the coal and colliers' wages questions in this part of the kingdom is sufficiently shown by the condition of the finished iron market on 'Change in Birmingham this — Thursday — afternoon. The market was excited on the matter of prices, owing, first, to the dearer fuel conditions which have resulted from the action of the coalmasters in giving notice of the withdrawal of discounts, and, secondly, to the continued upward tendency of pig iron. The Unmarked Bar Association and the Gas Tube Strip Association each held meetings, adjourned from last week, to consider the question of declaring an advance; and practically, as the outcome of at least the barmakers' meeting, common bars were 5s. per ton dearer, bringing the official price for this class of iron up to £6 and £6 5s. Makers declare that this same will be their quotation on Quarter Day—next Thursday—and that the continued advances in coal and pig iron leaves them no alternative unless they are to lose money on the orders accepted. Merchant bars are £6 10s. to £6 12s. 6d., and for superior sort £6 15s., while marked bars are for the present unaltered at £7 to £7 10s. Whether this will remain the price next week also is not quite clear, but it is generally expected it will. Hoops are £6 7s. 6d to £6 10s., and gas tube strip something approaching £6 per ton, these last makers this afternoon following hard in the wake of the unmarked bar makers in the matter of putting up prices.

Advices to hand during this week foreshadow a good export demand for the new quarter, especially in best iron and corrugated sheets for Australia, and cast iron pipes, wrought tubes, and machinery for the Cape. District consumers have been very busy for the last month or more, and are now requiring larger supplies of bar iron, tube strip, sheets, and hoops, than they have wanted for some months. The difficulty has lately been to obtain supplies of iron from the works fast enough. Sheets did not this afternoon participate to any considerable extent in the greater strength attaching to other descriptions of rolled iron. The competition in this branch from South Wales, the North of England, Lanchshire, and some other outside districts, as well as in internal competition among the local makers themselves, prevent much improvement. Doubles were £6 10s. to £6 12s. 6d., with a few makers quoting £6 15s. The last price, however, was an outside figure and seldom obtained, except by a few best firms. Galvanised sheets remained at £9 15s. to £10, f.o.b.; with a tendency on the part of makers to try and secure £10 2s. 6d., or even £10 5s., as a maximum for good sorts.

Pig iron keeps in short supply, and prices are very firm, particularly in view of the coming quarterly meetings, when a further advance is not improbable. Prices were quoted at 46s. to 46s. 6d. for Northampton forged pigs, 46s. to 47s. 6d. for North Staffordshire, and 47s. to 48s. for Derbyshire and similar grades. Staffordshire coal blast pig iron was quoted at the Association rate of 90s. per ton, and, owing to the combination, makers would not sell for less. Staffordshire all-mines—hot blast—were 52s. 6d. to 55s., and part-mines 45s. to 48s., running practically on all fours with Midland imported pigs.

Hematites were to-day—Thursday—mostly 60s. to 60s. 6d. for West Coast mixed numbers—Nos. 1, 2, and 3—but one or two makers asked as high as 62s. 6d. No. 1 foundry hematites were mostly quoted to new customers 61s. to 61s. 6d., but makers explained that they did not care to sell No. 1 in any large quantities separate from Nos. 2 and 3, since it left the latter numbers largely a drug on their hands.

Steel was in excellent request to-day in Birmingham, and makers have more work than they can get through. Prices are still moving upwards on the basis of £4 15s. to £5 for Bessemer billets and blooms, £5 to £5 5s. for best Siemens ditto, and £6 5s. to £6 7s. 6d. for girder and sections.

Interest was excited in a report that a large number of German firms, including Krupp, are combining to establish a general agency in China for obtaining contracts for railway and public works material. The orders secured are, it is said, to be "pooled."

Sir Benjamin Hingley, chairman of the Midland Iron and Steel Wages Board, has been called upon to act as arbitrator in connection with a sheet iron wages dispute at the Bousfield Ironworks, Stockton-on-Tees.

The heavy ironfounders have taken further orders for rolling plant, including satisfactory lines from iron and steel works on the Continent. The bridge and constructive people hold large contracts, and the galvanised iron manufacturers have a few better foreign orders. The engineers are well engaged, and can keep going several months on the existing orders for pumping plant wanted for mining and irrigation purposes.

Following the example set by the South Yorkshire coalowners, and by manufacturers in some other parts of the kingdom, a few large manufacturing firms in the Birmingham and Wolverhampton districts, nearly allied to the iron trade, have given notice to their workmen this week that all employés over sixty years of age will be discharged if considered by the foreman too infirm to be capable of following their employment with entire safety.

An interesting "demonstration" with a coal-gas driven motor-car has taken place this week in Birmingham, the inventor being Mr. W. H. Dunkley, of Birmingham, and the trial being held in the presence of a number of interested experts. In shape the vehicle somewhat resembles a bath chair, affording seating accommodation for one person. The extent and capacity of the car is, however, a matter which is regulated merely by the particular purpose for which any vehicle may be required. The body of the vehicle carries apparatus for compressing ordinary coal gas into a steel cylinder, and from this storage a regulated supply is admitted to the engine, which by means of a gearing drives the car. It is claimed that 30 cubic feet of coal gas will afford 1-horse power for an hour, so that the cost of propulsion with gas at about half a crown a thousand cubic feet is not extraordinarily high. The car worked very well, the smell of exhausted gas and the vibration being apparently slight.

## NOTES FROM LANCASHIRE.

*(From our own Correspondents.)*

*Manchester.*—Throughout all branches connected with engineering, iron, and coal, the outlook, so far as trade is concerned, is a satisfactory one for the immediate future. The iron and coal-using industries of this district are all actively engaged, with the result that requirements for both raw and manufactured material are more than taking away the present production; whilst as regards fuel, pits, considering the season of the year, have perhaps not for a considerable time past been in a more satisfactory position with regard to moving away their output, and there are very few collieries in this district that, so far, have been under the necessity to go on short time. With respect to prices, although these in the iron and steel trade have perhaps not advanced to the extent that might have been anticipated on raw material, a strong upward move is now showing itself in most descriptions of manufactured material, and the difficulty is becoming one not so much of price as of delivery.

Generally a stronger tone was noticeable on Tuesday's Manchester Iron Exchange, and in pig iron, which has been the quietest feature in the market, there was more inquiry stirring, with a hardening up on some brands, which have recently been to a certain extent weakened by speculative transactions. For local and district brands quotations were unchanged, but very firm at full rates of 47s. 6d. for forge, to 49s. 6d. for foundry Lancashire, less 2½; 43s. 6d. for forge, to 46s. for foundry Lincolnshire, and 50s. to 51s. for foundry Derbyshire, net cash delivered Manchester, with makers as a rule so well sold that they are indifferent about booking further orders at present. Outside brands offering here have stiffened up slightly upon the minimum figures recently quoted, good foundry Middlesbrough not averaging under 48s. 10d. to 49s. 4d. net delivered by rail Manchester, with Scotch iron, delivered Manchester docks, about 49s. 9d. to 50s. for Glengarnock, and 50s. 3d. to 50s. 6d. for Eglinton, net, and American pig iron 47s. 6d. for ordinary to 50s. and 50s. 6d. for special brands, net cash.

With regard to finished iron there has been a strong hardening up in prices for bars; although there is not as yet any officially announced advance on the basis, Lancashire bars are not quoted under £5 17s. 6d. to £6, with North Staffordshire £6 to £6 2s. 6d., and it is not improbable that £6 will before very long become the minimum for Lancashire, and £6 5s. for North Staffordshire, delivered in this district. Other descriptions of finished iron show no improvement; sheets remain weak at about £6 17s. 6d. to £7 2s. 6d., and in hoops only an indifferent business is being done at the association list rates of £6 10s. for random to £6 15s. for special cut lengths, delivered Manchester district, and 2s. 6d. less for shipment. Nut and bolt makers report rather more business coming forward, and list rates are very firm, with a probability of some advance on these, following the upward move in material.

In the steel trade hematites are without quotable change at about 59s. and 59s. 6d. up to 61s. 6d., less 2½, with local-made billets £4 10s. net cash; but prices for manufactured steel have gone up quite 2s. 6d. per ton, the better qualities of bars being quoted £6 10s. to £6 12s. 6d.; common steel plates also £6 10s. to £6 12s. 6d., whilst £7 is now the general quotation for boiler plates delivered in this district.

Ample evidence of the continued satisfactory position of the engineering industries is afforded by the extensions of works that are being carried out in various directions, whilst in most of the leading branches there is an unmistakeable stiffening up in prices on new orders—of which there is no scarcity, but rather more than most firms are in a position to entertain—that are now being placed. If there is any change, it is, perhaps, that machinists are not booking new work quite so freely as of late, but they are still all very well engaged. In fact, practically all departments of engineering continue so full of work that, with very few exceptions, the orders already on the books will see them through the remainder of the year.

A couple of important undertakings, which will largely contribute towards developing the industrial enterprise of this district, are now bringing themselves into sufficient evidence to call for notice. The new grain elevator on the banks of the Manchester Ship Canal, to which I have previously made brief reference, has now been completed, and provides a storage of 40,000 tons of grain, whilst its special arrangements enable grain cargoes to be discharged at the rate of 350 tons per hour, the grain being weighed continuously while being conveyed from the vessel to the elevator. The appliances for the delivery of the grain are of the most modern character, and so arranged that the grain can be sacked, weighed, and loaded into forty railway wagons and ten carts simultaneously all under cover, whilst ample provision is made for drying the grain, and in the event of cargoes arriving in a heated state they can by means of the dryer be quickly brought into a marketable condition. The other important undertaking is the partial opening of the Great Northern goods depôt, which when completed will be a very important addition to the railway facilities of Manchester for dealing with traffic, both generally and in connection with the Manchester Ship Canal.

Amongst the numerous works extensions that have recently been carried out or are in progress in this district I may mention that West's Gas Improvement Company, Limited, has just completed important additions to its works and plant. The pattern shop has been enlarged to almost double its previous capacity, and the platers' department has been considerably extended. The company has also opened a separate department for the manufacture of retort mouthpieces, covering a floor space of 33ft. wide by 150ft. long, and in this branch a good deal of special plant has been put down, including a couple of machines, right and left-hand, for planing the mouthpieces. In the machine shop five new lathes—three 10in., one 9in., and one 8in.—and four drilling machines, of special type, have been added to the existing plant, and the shop engine has been fitted with an automatic Proell cut-off arrangement, in place of the ordinary slide valve, with very satisfactory results as regards economy in steam. The firm, I may add, has just completed one of the West and Jenkins air compressors, of the double-stage and intermediate cooler type, for the Crystal Palace Gasworks; and it has similar ones in course of construction for the Sheffield, Nottingham, and Newcastle works. In connection with stoking machinery—the advance of which is more marked at the present time than it has ever been — the company is fitting up during the present year fifty-four charging and drawing machines for fourteen retort houses in various parts of the country, on the Continent, and at Buenos Ayres. It has also erected a number of coal conveyors for coal stores, and is making a speciality in coke-conveying plant for dealing with hot and cold coke from the retort houses of gasworks. For this and other purposes the company has taken up the manufacture of an improved roller chain, which has been patented by Mr. Charles Hunt, of the Birmingham Gasworks, specially designed to deal with materials of a gritty and cutting nature, such as coke. Other chains that have been tried for the same purpose have, as a rule, failed in a very short time, owing to their getting out of pitch, and wearing quickly at the points that come in contact with the chain wheels. The roller form of chain invented by Mr. Hunt obviates these difficulties, and amongst its special features is a stationary pin, for which ample bearing surface is provided, whilst there is also increased surface for carrying the roller, which slides upon the sprocket wheel as it passes round. This chain is adapted not only for coal and coke-conveying plant, but also for ordinary elevators and conveyors, whilst a special pattern is being prepared for dredger requirements.

In view of recent overwinding accidents at coal pits it will be of interest to notice a new controlling apparatus—Lymn and Critchley's patent—for application to colliery winding engines, which is being introduced by Messrs. Wm. Wilkinson and Co., Limited, Holme House Foundry, Wigan, and which I understand has given very satisfactory results at a colliery in the above district. This controller is arranged with positive gear, in such a manner that should the engineman in charge become suddenly indisposed, or should he leave his post at the starting and reversing handles, while the engines are in motion, the engines would immediately be brought to a stop, irrespective of the position of the cages. In the event of the engineman not shutting off the stop valve at the appointed number of revolutions from the surface, the controller shuts it off automatically, whilst it also reverses the engines in case he does not reverse the valve motion at the appointed number of revolutions from the surface, to check the speed after closing the stop valve. Should the engine be accidentally started the wrong way, the controller instantly takes charge, and shuts off steam and applies the steam brake simultaneously, thereby preventing the cage ascending into the headgear. It may also be pointed out that where there is a fair distance between the detaching hook and the collar, it would be impossible for the hook to go into the collar after the controller had acted.

In the coal trade here, except as regards the better qualities suitable for house-fire purposes, which are just now only in very slow request owing to the season of the year, a fairly active demand is reported generally, and all descriptions for iron-making, steam, and manufacturing requirements are moving away freely, with 7s. per ton readily got for good ordinary qualities of steam and forge coal at the pit mouth. In some quarters supplies of engine classes of fuel are rather plentiful, but generally the quality offering on the market is not in excess of requirements, and prices are firm at recent quotations, common sorts fetching 3s. 3d. to 3s. 6d.; medium, 3s. 9d. to 4s. 3d.; and best descriptions of slack, 4s. 6d. to 4s. 9d. per ton, at the pit mouth. As regards forward contracts, the position remains very much as I have reported recently, colliery proprietors generally holding out for advances on last year's rates of 6d. to 9d. on round coal and 3d. to 5d. per ton on engine fuel, with the minimum advance in most cases obtained without difficulty.

A fair business continues to be reported in the shipping trade, with good qualities of Lancashire steam coal fetching 8s. 6d. to 8s. 9d., delivered at Mersey ports.

*Barrow.*—There is a good market for hematite qualities of pig iron, and sales are well maintained, especially for parcels of Bessemer mixed numbers, which are quoted at 51s. to 52s. 6d. net f.o.b. Warrant iron is steadier at 50s. 7½d. net cash sellers, 50s. 7d. buyers, and during the week a considerable business has been done, resulting in the aggregate in the reduction of stocks by 4903 tons, and leaving stocks in hand at 154,450 tons, or 30,000 tons less than at the beginning of the year. There are 40 furnaces in blast, as compared with 37 in the corresponding week of last year. There is but a poor trade in forge and foundry qualities of metal, but that is because the output is restricted to Bessemer descriptions.

Iron ore is in very brisk and very steady demand, and raisers are very actively employed in the work of producing as much metal as possible for the furnaces in blast in the district, and for consumers who draw their supplies from West Coast ports. Prices are firm at 12s. to 14s. for good average qualities net at mines. Best sorts are at 16s. to 17s. per ton, and Spanish ores, which are in smaller delivery, are selling at 17s. to 17s. 6d. net at West Coast ports.

In the steel trade a very active market prevails, and makers are not only very fully supplied with orders, but are in receipt of inquiries which assure them of a continuance of activity for a long time to come. Prices are firm all round, and heavy rails are at £4 10s. per ton net cash, and heavy plates for shipbuilding purposes at £6 per ton. The minor departments of the steel trade are well employed.

The shipbuilding trade is very busy, and likely to be much busier. At the launch of H.M.S. Amphitrite at Barrow this week, Sir William White, Assistant Controller of the Admiralty and Director of Naval Construction, denied all the rumours that have lately been afloat as to the failure of H.M.S. Powerful, built at Barrow. He pointed out that she had exceeded every promise made by her designers as to speed, &c., and that she had more than fulfilled the conditions set out by the contractors. He deprecated anonymous naval critics who knew nothing of the conditions as to the service any class of ship was intended for, and nothing of the varying conditions under which a ship took her trials.

Coal and coke are in brisk and active demand at full prices.

The shipments of pig iron from West Coast ports during last week show an increase on the week in pig iron to the extent of 3803 tons, the bulk shipped being 9411 tons, against 5608 tons in the same week of last year. The steel shipments show a decline of 185 tons on the week, being 6965 tons, compared with 7151 tons. This year pig iron shows an increase of 30,260 tons, the totals being 253,790 tons, against 223,530 tons last year. The steel exports stand at 276,864 tons, against 227,476 tons last year, an increase in favour of 1898 of 49 388 tons.

## THE SHEFFIELD DISTRICT.

*(From our own Correspondent.)*

IN the South Yorkshire coalfield business in several directions has been a good deal interrupted by the strike of pit lads. At two important collieries the strike took the management entirely by surprise. Not the slightest intimation was given that any stoppage of the collieries was intended. The pits were open for work, and the men and lads were alike on the pit hill in the morning, when the youths decided that they would not go down. Of course this action on their part prevented the collieries being worked. The disturbance has been rather a grave one, affecting an output of some 45,000 tons of coal per week as far as it has gone at the time of writing. Legal proceedings have been taken with the view of making an example of several of the 220 of these youths who neglected work.

There has been a great deal of talk over the Workmen's Compensation Act, which came into operation last Friday. The men regard the action of the employers in forming themselves into a mutual insurance association as an indication that they will contest all claims with great tenacity, and they anticipate that litigation will be more frequent than ever. The scheme formulated by the management of the Miners' Permanent Fund has not been received with any favour.

No great excitement has been caused by the wages question, as the matter is entirely left for the Miners' Federation, whose decision will be accepted as authoritative. There has been a rather quiet demand for house coal since the warmer weather set in, although the stoppage of supplies from South Wales has kept the trade rather above the average. The scarcity caused by the strikes in Wales is preventing accumulations in stocks at pits, the strike of pit-lads, of course, also contributing to clear off the quantities brought to bank. Best Silkstones make 9s. to 9s. 6d. per ton; ordinary, 7s. 6d. per ton; Barnsley house, 8s. to 8s. 6d. per ton; seconds, from 7s. per ton. Steam coal is still largely called for. Much inconvenience is caused by the stoppage of certain pits from which Hull and Grimsby draw large supplies for export business. Barnsley hards make 7s. 9d. to 8s. 6d. per ton; seconds, from 6s. 6d. per ton. Engine fuel for large railways is not in excess of market requirements. Nuts make 6s. to 7s. per ton; screened slack, from 4s. 6d. per ton; pit slack, from 2s. 6d per ton. Owing to the excessive demand for coke, an advance of about 3d. per ton has been realised. Quotations generally run as follows:—Ordinary qualities, 9s. to 10s. per ton; best coke, 11s. to 12s. per ton.

Several coal companies in the immediate neighbourhood of Sheffield have issued circulars announcing that, in consequence of the Workmen's Compensation Act coming into operation, they have advanced the prices of coke by 6d. per ton, and by 3d. per ton for coal and slack. It is reported that trade in the Sheffield district is exceptionally good in steam coal, both for home consumption and export. It is not anticipated that any difficulty will be experienced in obtaining the advances mentioned.

A record consignment of coal from Hull is worth a note. The steamer Angola left Hull a few days ago with 5782 tons of Aldwarke Main steam coal—John Brown and Co.'s collieries. As the bunker coal weighed 1314 tons, the cargo carried out of port by that vessel was 7096 tons. The contents of this steamer were brought to Hull in about 890 wagons, or thirty full train loads, and these wagons, standing on the railway, buffer to buffer, would cover a length of about 3¼ miles. The whole of this coal was placed on board the Angola in five days. The steamer was bound for Rio.

In the iron and steel trades business continues as reported last week. No changes in prices have taken place during the last week or two. Hematites are now at 59s. to 61s. per ton, according to brand; forge iron, 42s. 6d. per ton, all delivered in Sheffield. Armour plate mills are as busy as they can be, and all other

branches of the heavy trades in Sheffield are exceptionally brisk.

Messrs. Vickers, Sons, and Maxim, Limited, ran a special train from Sheffield on Tuesday, to enable as many of their Sheffield workpeople as possible to witness the launch of the protected cruiser, Amphitrite, which is the first war ship constructed by the company since the acquisition of the Naval Construction Works at Barrow-in-Furness. At the luncheon which followed the proceedings, Mr. Hiram S. Maxim stated that in conjunction with Lieutenant Dawson he was engaged upon an invention which would effect a revolution in the firing of heavy artillery. Under ordinary practice the guns were worn out after a few shots. The causes which brought this about had been discovered and a remedy hit upon. By a process which had never been employed before, and which prevented the erosion which wore out the gun, these causes had been eliminated, and the life of the gun would be extended more than ten times.

## NORTH OF ENGLAND.

*(From our own Correspondent.)*

A MORE noticeable improvement may be reported this week in the iron trade of this district than has been experienced for a considerable period, and though the business transacted is still comparatively small this is more owing to the attitude of the sellers than the buyers. The latter are more disposed to operate, but the makers, expecting that the demand will be a good deal stronger soon, are holding off, as they can well afford to do, seeing that they are very fully supplied with orders for execution this month, and they are not badly off for August. As a matter of fact, the usual experience is that there is an upward movement about this time of the year, and the best policy of producers seems to be to wait. Comparatively little of the iron that will be produced this month is available for sale, and it is pretty clear that stocks are small, because, though no official information is forthcoming concerning this, the difficulty there frequently is in getting vessels loaded affords an indication that makers are not well provided with iron.

Makers have advanced their price for prompt f.o.b. deliveries of No. 3 Cleveland pig iron to 40s. 6d., and neither maker nor merchant has been prepared to book at anything less than 40s. 3d. this week. Some would take 40s. 6d. for delivery during August also; but the leading producers are at 41s. Only a short time ago it was easy to buy No. 3 at 40s. No. 4 Cleveland foundry pig iron realises 39s. 6d., and grey forge has been advanced to 38s. 6d. again, with mottled and white at 38s. 3d. Basic pig iron is up to 44s. 6d. for mixed numbers.

The accountants have officially ascertained that the average price realised by the ironmasters in this district for No. 3 Cleveland pig iron during the past quarter was 40s. 3·3d. per ton, this being 3·17d. less than in the present quarter; and wages for the present quarter are reduced three-quarters of 1 per cent.—they will be 8 per cent. above the standard, instead of 8·75 per cent. above, as they were last quarter. The railway rates for iron-making materials, which are regulated by this return, will remain unaltered. It is remarkable that the realised price should have come out so near that of the corresponding quarter of last year, which was 40s. 0·11d. per ton. The present return shows an increase of 3s. 9d. per ton on the returns for the last quarter of 1895, when the lowest figure of late years was reported.

East Coast hematite pig iron is dearer, mixed numbers being generally quoted at 51s. 6d. per ton, and there is scarcely any obtainable now at 51s. The advance is brought about by the apprehensions as to difficulties in securing supplies of ore from Spain, if the threat of the United States to extend the war to Spain in Europe is carried. If the supplies of ore are interfered with the matter will be a very serious one for this district, which has to rely upon Spain for ore. The imports of foreign ore into Middlesbrough have been very heavy of late; last month the quantity was over 120,000 tons, and for the second quarter of the year 335,273 tons, or 20 per cent. more than in the first quarter of the year. Makers thus have large stocks of ore to draw upon. The lowest figure for Rubio ore, delivered at the wharves on the Tees or Tyne, is 14s. 3d. per ton for prompt delivery, but merchants will not sell for forward delivery.

The stock of Cleveland pig iron in Messrs. Connal and Co.'s warrant stores at the end of June was 90,075 tons, the decrease for the month being 2581 tons, while the stock of hematite was 44,999 tons, decrease 390 tons.

The foreign demand for finished iron and steel has slackened, but there is an increase in the home requirements which is satisfactory to manufacturers, as they secure better prices, the competition being less keen than it is for foreign orders. Very low prices have generally to be taken for the latter, owing to the cheap rates quoted by German and Belgian producers. The home demand was probably never so good as it is at present, and especially is this the case for such iron and steel as is used by the shipbuilders. Steel ship plates are not under £5 18s. 9d.; iron ship plates, £5 12s. 6d.; steel ship angles, £5 15s.; iron ship angles, £5 8s. 9d.; common iron bars, £5 7s. 6d.; packing iron, £4 17s. 6d.; steel sheets—singles—£7 2s. 6d., all less 2½ per cent. discount, and f.o.t. A fair trade is being done in steel rails, there being an increase in demand on Indian account. Mr. Thomas Williams has been appointed works manager of the Moor Iron and Steel Works, Stockton, in place of the late Mr. Llewellyn Roberts. Mr. Williams has for many years been connected with the establishment.

The late Mr. Thomas Mudd is to be succeeded as manager of the Central Marine Engine Works, Hartlepool, by Mr. W. Cameron Borrowman, Wh. Sch., A.M. Inst. C.E., who is at present assistant manager of the engine works of Messrs. Barclay, Curle, and Co., of Glasgow. Previous to undertaking that appointment he was for ten years with Messrs. R. Napier and Sons, of Glasgow. Mr. Borrowman at the outset of his career won one of the Whitworth scholarships—the fourth in the kingdom—and many medals and other scholarships. He also obtained a diploma of the University of Glasgow for mechanical engineering, and for a short time was chief assistant to Principal Jamieson, F.R.S., Professor of Engineering at that University, and he aided that gentleman in the preparation of some of his text-books for publication.

Messrs. William Harkess and Sons, of Middlesbrough, have just completed a vessel for the Russian navy, the first built on the Tees, and a few days ago she was consecrated by the Very Rev. Eugene Smirnoff, the Russian chaplain. The vessel was named the Pachtusoff, and is to be employed in surveying and making charts of the Siberian coast.

The coal trade is healthy and active, the collieries having been very fully employed indeed, in order that the orders that accumulated during the holidays might be overtaken. The labour difficulties in South Wales and the threatened trouble in South Yorkshire are leading consumers abroad to buy more freely from the North of England, and the Baltic trade is brisker than usual. The shipments to Mediterranean ports have also of late been uncommonly large, and the prospects are that the trade will not see any abatement of activity until the end of autumn at soonest. Sellers quote 13s. per ton f.o.b. for best steam coal, and have no difficulty in getting it. The contract for supplying the Daira Sanieh, Egypt, has been divided between the Cowper and Bothal Collieries, Northumberland, and the price is said to show a satisfactory advance on the last half year's contracts Between 40,000 and 60,000 tons of steam coal will be required during the current half year. The demand for gas coal was never larger at this time of the year than it is now, and the price of best qualities is between 9s. and 9s. 6d. per ton f.o.b. The Durham miners have come to an understanding with the owners on the question of the Workmen's Compensation Act, and a Board of Arbitration has been appointed to deal with the claims upon a fixed scale. The Cleveland ironstone miners are endeavouring to arrange with the employers for the appointment of a committee to deal with claims under this Act, and the masters are favourable.

## NOTES FROM SCOTLAND.

*(From our own Correspondent.)*

THE pig iron market has been quiet this week, there being scarcely any speculative business in warrants, while consumers are purchasing very little iron. The near approach of the Glasgow Fair holidays, which begin next week, is already telling adversely on the market. Business in warrants has been unusually limited. Scotch warrants have sold from 45s. 10d. to 45s. 11½d. cash, at 46s. for delivery in ten days, and from 46s. 0½d. to 46s. 1½d. one month. Cleveland iron has been in poor request, the business done being at 40s. 0½d. to 40s. 1½d cash, and 40s. 3d. to 40s. 3½d. one month. There has been very little demand for hematite for immediate delivery; a small quantity of Cumberland warrants changed hands at 50s. 6d. cash. For delivery in one month somewhat more business was done in this class of iron at 50s. 8d. to 50s. 10d. per ton.

The average price of Scotch pig iron warrants during June was 45s. 11½d. against 46s. 8½d. in May, 46s. 2d. in April, 46s. 3d. in March, 45s. 9½d. in February, and 45s. 9½d. in January.

For the whole half-year the average price has been rather over that of the corresponding period of 1897, and during the greater part of the time prices have been remarkably steady.

The prices of Scotch makers' pig iron are as follows:—Govan and Monkland, f.o.b. at Glasgow, Nos. 1, 46s. 7½d.; Nos. 3, 46s. 1½d.; Wishaw and Carnbroe, Nos. 1, 46s. 9d.; Nos. 3, 46s. 3d.; Clyde, No. 1, 51s.; No. 3, 47s. 6d.; Gartsherrie and Calder, Nos. 1, 51s. 6d.; Nos. 3, 47s. 6d.; Summerlee, No. 1, 52s.; No. 3, 47s. 6d.; Coltness, No. 1, 55s.; No. 3, 48s.; Glengarnock, at Ardrossan, No. 1, 51s. 3d.; No. 3, 46s. 3d.; Eglinton, at Ardrossan or Troon, and Dalmellington, at Ayr, Nos. 1, 47s. 9d.; Nos. 3, 46s.; Shotts, at Leith, No. 1, 52s. 6d.; No. 3, 48s. 6d.; Carron at Grangemouth, No. 1, 52s.; No. 3, 48s. 6d.

There are 81 furnaces in blast in Scotland, compared with the same number at this time last year, and the total is made up of 43 furnaces which are producing hematite, 32 ordinary, and 6 basic iron.

Scotch-made hematite pigs are in fair demand at 54s. per ton delivered at the steelworks.

Stocks of Scotch pig iron are slowly decreasing. The reduction in the stock in Glasgow stores in the past week has been 308 tons, and the decrease for the past six months is 8683 tons. The arrivals of Middlesbrough pigs at Grangemouth were 6352 tons, showing a decrease for the week of 3143, that for the half-year being now 6418 tons.

Iron and steel manufacturers have much reason to be satisfied with the business of the past six months. The trade in finished iron has been steadily maintained, and there are hopes that it may be further increased. The steel trade has been remarkably busy, many of the works being kept in operation day and night, and heavy contracts are in hand. It is understood that most of the steelmakers have orders on their books that will keep them going beyond the close of the present year. Locomotive engineers are equally well supplied with work, and founders and pipemakers are likewise busy.

The coal trade has been very busy in the past week, especially in the shipping department. The clearances at the various Scottish ports are the largest on record, amounting to 253,719 tons, compared with 237,707 in the preceding week, and 192,714 in the corresponding week of last year. There is an increase in the shipments for the past six months of fully 800,000 tons. The inland trade in coals has been brisk, as well as the export branch, and prices have been firm. Main coal is quoted f.o.b. at Glasgow harbour 8s. 9d. to 9s.; splint, 9s. 6d.; ell, 9s. 3d. to 9s 6d., and steam, 11s. 3d. to 11s. 6d. There has been an exceptionally brisk demand for splint coal in anticipation of holidays in the mining districts.

During June 47,862 tons of new shipping was launched from the Clyde shipyards, compared with 29,243 in the same month of 1897. The output from the Clyde yards for the six months is the greatest on record, amounting to 207,538 tons, compared with 149,254 in the corresponding period of last year.

## WALES AND ADJOINING COUNTIES.

*(From our own Correspondent.)*

A FAIR amount of business continues in the coal trade, and some of the special features noticed in the Cardiff districts have been an increased demand for small steam and higher quotations and continued firmness in the house coal trade. Last week the totals were well maintained, and this week substantial consignments have been despatched to Genoa, Valparaiso, Colombo, Cronstadt, Oporto, and Alexandria. One of the items of the week has been a cargo of 3000 tons patent fuel to Vera Cruz.

Prices rule firmly. On 'Change, Cardiff, mid-week, closing figures were as follows:—Best steam, 21s. to 22s.; drys, 15s. to 16s. 6d.; best Monmouthshire, 17s. to 18s.; best steam, small, 11s. 3d. to 11s. 6d.; seconds, from 9s.; best house coal, 16s. to 17s.; No. 2 Rhondda, 13s. 9d. to 14s.; small, 9s. to 9s. 6d.

Swansea prices:—Anthracite, 12s. to 13s. 6d.; second quality, 11s. to 12s.; ordinary large, 10s. to 11s. 6d.; small rubbly culm, 5s. 6d. to 6s., Swansea f.o.b. cash thirty days, less 2½. Steam coal, bituminous coals, coke and patent fuel still remain unquoted: prices subject to private arrangement. At Cardiff patent fuel is quoted at 16s. to 18s.; furnace coke, 18s. to 19s.; foundry coke, 20s. to 22s. Pitwood, 13s. 9d. to 14s.

In the iron and steel works there has been no lack of activity shown in carrying out repairs, and in some quarters these have been extensive. I nete also that some of the brick works have been re-started, though this, with a slight manufacture of iron and steel, are simply providing materials for repair and extension. Two consignments of rails left Newport this week. Swansea imported 2250 tons pig iron, 222 tons steel scrap, and the unusually large quantity of 5888 tons iron ore. In my visit to the leading works I have noticed of late considerable additions to iron ore stock. Cyfarthfa is well supplied, and at some works Elba ore figures with that from Bilbao. Cardiff prices are: Rubio, 13s. 9d. to 14s. Tafna, 13s. 3d. to 13s. 6d.

The first results of the Workmen's Compensation Act are beginning to be shown. Without specifying any particular iron and steel works, I may state that already in this, the first week of the Act coming into force, about a hundred old men have been paid off, who, but for the Act, might have been continued for years. In all the cases noticed there have been substantial signs for refusing to continue them in employment. The vision of one was slightly bad, the hearing of many defective, and not a few exhibited feebleness of gait, all of which infirmities, in a busy works with a network of rails, were sources of danger. As one of the managers observed, in reply to an appeal, "I cannot afford to run the risk of keeping you on, in face of the Compensation Act." Taking the number at a hundred or two hundred, the percentage so far is small; but in all likelihood the weeding out—much to the regret of employers, I am certain—will in a short time total up to a serious number.

A new colliery is being sunk at Bryncettim by Mr. Jonah Jones, formerly the manager at Park Slip Colliery.

On 'Change, Swansea, it was stated this week that no new features had cropped up of late in respect of pig iron.

Closing prices iron and steel, Swansea, were as follows:—Pig iron: Glasgow warrants, 45s. 11d. cash buyers; Middlesbrough No. 3, 40s. 1½d.; prompt other numbers in proportion; hematite warrants, 30s. 6d. for mixed numbers, f.o.b.; Cumberland according to brand.

Welsh bars, sheet iron, steel nails, and steel rails, remain unquoted, prices subject to private arrangement. Tin-plates: Makers' quotations for Bessemer steel: Coke, 10s. to 10s. 3d.; Siemens, coke finish, 10s. 3d. to 10s. 6d.; ternes, per double box, 28 by 20 C., 19s., 19s. 6d. to 21s.; best charcoal, 11s. to 12s. Finished black plates, £8 to £8 10s. per ton; Canadas, £7 to £7 10s., according to finish of brand; block tin, £71 17s. 6d. to £72 5s. Lead: English, £13 7s. 6d.; Spanish, £13 5s. Copper: Chili bars, £50 12s. 6d. to £50 18s. 9d.

The only furnaces working in the district are Siemens. These turn out nearly enough tin bar for the number of mills working, so the outlook is not a good one for the stagnant works on the hills.

It is reported that some of the smaller works are beginning to suffer from the scarcity of bars, owing to the total stoppage of the Upper Forest steel department. The make of tin-plate has been fairly equal at the works. The total make last week was 50,571 boxes and the shipments totalled 56,475 boxes. Present stocks, 145,643 boxes as compared with 151,547 boxes this day week and 150,061 boxes at this date last year.

The new list of wages to tin-plate workmen is now out, and is being very generally discussed. It is expected that the workmen will appoint representatives to meet the masters and discuss what the men consider its objectionable features, though action is taking place now, and various works were posted with notices on Saturday.

I regret to announce the death of Mr. Wm. Beith, M.E., in his fifty-third year. He had been associated with several important colliery works in Wales.

The preamble of the Cardiff Railway Bill has been passed, subject to the withdrawal of certain clauses. Amongst the points refused are 17a, or running powers into Merthyr station, and also refusal to sanction the spur by which it was proposed to connect the new railway with the joint line at Treharris. The clause giving power to the Cardiff Railway Company to run over the Rhymney, in the event of similar facilities being conceded to any other company, stands part of the Bill.

The preamble of the Barry Railway Bill has also been passed. This gives the company an inlet into the Brecon and Merthyr Railway district.

The preamble last week was passed of the Fishguard and Rosslare Railways and Harbours.

The opposition to the Usk Valley Railway Bill having been withdrawn, it has been referred to the consideration of the Committee on Unopposed Bills, having already been passed by the House of Commons.

## NOTES FROM GERMANY.

*(From our own Correspondent.)*

THE tone of the Rhenish-Westphalian iron market is getting stronger from week to week, the various establishments being in full activity, while inquiries increase. Consumers experience some difficulty in placing orders for immediate delivery; in the manufactured iron and steel trade, for instance, the majority of the mills are too busy to care for fresh work just at present. Quotations, naturally, are very stiff, but have not been officially raised since previous letters. A decided change for the better has taken place in the sheet trade, quite a brisk activity being now reported at most of the mills; plates, too, are in strong request. The business done on foreign account has been fairly good upon the week, demand for almost all articles of iron and steel having improved, and it is gratifying to note that prices, too, show an inclination to rise. Activity at the machine and wagon factories and also at the tube mills is exceedingly animated.

In Silesia the different branches of the raw and finished iron trade are, likewise, healthily engaged, prospects for further employment being very good, and there is much firmness perceptible in quotations.

Production of pig iron in Germany, including Luxemburg, was for May of present year 610,553 t., of which 129,583 t. were forge pig and spiegeleisen, 47,166 Bessemer, 331,805 t. basic, and 101,999 t. foundry pig. Output of pig iron in April of present year was 583,418 t., while in May last year 579,613 t. were produced. From January 1st to May 31st of present year 3,003,496 t. pig iron were produced, against 2,799,512 t. for the corresponding period the year before.

The outlook of the Austro-Hungarian iron market is anything but bright. Only in merchant iron a fair trade is done, dealers buying pretty largely in expectation of a good harvest; girders, however, and plates and sheets are in comparatively weak request, especially in Hungary. Orders for locomotives and wagons have been coming in pretty freely of late; in Hungary seventy-six express locomotives and nine hundred goods wagons have just been ordered, and so the railway department is at least one that will be actively engaged for some time ahead.

Official quotations, free Vienna, have been last week as under:—Styrian bars, 112fl. to 122fl.; the same Bohemian quality, 110fl. to 114fl.; ditto Hungarian, 108fl. to 111fl.; girders 111fl., in some instances 125fl.; steel plates, 132fl. to 160fl.; boiler plates, 150fl. to 180fl.; all per ton. Styrian pig iron is quoted 45½fl. to 51fl.; ditto Moravian, 42fl. to 50fl. p.t.

A good business is done on the Belgian iron market, the tone, generally, being strong. Reports given of the home and foreign trade are decidedly favourable, and there is reason to anticipate a steady, if not a very extensive business. The orders given out during the week now past have been fairly large; merchant bars No. 2, for export, are quoted 127·50f. p.t.

In Servia a pretty lively trade has been done in iron and steel. Imports from Austria-Hungary were:—Two wagons bars and one wagon wire nails; 84 q. steel and 63 q. iron and steel manufactured goods.

The position of the iron market in Russian Poland is very firm, and the outlook for business in the future may be considered as favourable. Merchant iron that has been imported is quoted 1·72 to 1·74 roubles per pud, free Sosnowice, while home make is sold at about 4 kopeken per pud less; bars made in Poland are, however, only with difficulty obtainable just now, as the inland mills are crowded with work, and do not care to accept fresh orders unless very long terms of delivery are granted them. Foreign plates in iron have been sold at 1·98 roubles per pud, free Sosnowice. Angles made in Russian Poland are quoted 2·20 to 2·35 roubles, free Warsaw; hoops, 1·90 to 1·98 roubles; girders, 2·18 roubles.

A joint-stock company, with a capital of eight million roubles, has recently been formed in St. Petersburg for the purpose of gaining silver, copper, and tin in Minussinsk, in Siberia, where layers of silver, tin, and copper ore have recently been found.

The Russian Minister of Finance has granted to a Rhenish-French joint stock company, called Société Générale de Hauts Fourneaux, Forges et Aciéries en Russia, the permission to commence operations in Russia. The works will be built near the town of Taganrog, the capital of the company amounting to about eighteen million roubles.

Last year's shipments in manganese ore from the mining company in Kassandra were, from the port of Scratoni, 30,000 t., while from the port of Salonica about 400 t. antimonious ore and 6500 t. chrome ore were shipped during the past year.

## THE NEWPORT HARBOUR COMMISSIONERS' WEEKLY TRADE REPORT.

EXPORTS for week ending July 2nd were:—Foreign, 1738 tons; and coastwise, 8766 tons. Imports for week ending July 5th were:—1488 pieces of timber, 50 loads pitwood, 580 tons of pig iron, 226 tons of old iron, 3 cargoes of slates, and 1450 sacks of grain.

Coal: No quotations. Pig iron: Scotch warrants, 46s.; hematite warrants, 50s. 8½d., f.o.b. Cumberland; Middlesbrough, No. 3, 40s. 3d. prompt. Iron ore: Rubio, 13s. 6d. to 13s. 9d.; Tafna, 13s. to 13s. 3d. Steel: Siemens steel tin-plate bars, £4 10s., all delivered in the district, cash. Tin-plates: Bessemer steel, coke, 9s. 9d.; Siemens, coke finish, 10s. Pitwood, 15s. 6d. London Exchange Telegram: Copper, £50 15s.; Straits Tin, £71 17s. 6d.

## AMERICAN NOTES.

*(From our own Correspondent.)*

NEW YORK, June 24th.

IRON and steel are less active. Large consumers have evidently decided to wait until after July 1st before making further contracts. The public mind is considerably disturbed over war operations, and much business is held in abeyance. Meanwhile reports of contemplated work are heard. The railway interests will probably lead during the latter half of the year in the purchase of equipment. Boards of directors have been considering a general re-equipment, and much financing has been done by some roads to that end. The volume of traffic is heavy, but the fact is recognised that manufacturing activity is not on a sufficiently productive basis to warrant a departure from the long-pursued conservative course. Quotations appear to have reached a level below which restriction is the only alternative. While many reports say pig iron is weaker, none is selling at lower prices. Orders for some 4000 box cars will probably be placed soon, one-half by one large Corporation. Contracts for about one hundred locomotives are on the point of being placed, part of them for European and Asiatic delivery. As usual the plate and structural mills are very busy, and much business is coming to the surface, under the influence of which quotations for small early delivery lots are hardening. Considerable pipe line work is coming up. There is very little tramway construction, but building operations, ship and boat work, shop extension, and the like promise a great deal of activity in the furnishing of supplies. Merchant bars are dull; many mills are working half time. A million-dollar steel plant, it has been decided, will be erected in Alabama. Billets are 15 dols. at Pittsburgh. The market is in a position where a trifling cause is liable to precipitate an active demand.

## UNIVERSITY COLLEGE, LIVERPOOL.

THE annual gathering of the engineering department took place on the 1st inst. in the Walker Engineering Laboratories. In addition to a large number of students, there were many of their parents and friends present, besides Mr. George Rathbone, member of the College Council; Mr. W. Hewitt, director of technical instruction; Professor Hele-Shaw; Professor Paterson, Dean of the Medical Faculty; Dr. Stanton; Dr. Howard; Messrs. Hay, Anderson, Donaldson, and Garner, and other members of the engineering staff. Previous to the meeting an exhibition of work, including drawings, designs of machines, and work in pattern-making and metal working, was held in the Museum. The chair was taken by Mr. George Rathbone.

Professor Hele-Shaw proceeded to read the annual report, showing the following as having obtained first class in the college examinations:—Engineering—First year: L. Sproule, J. Alexander, S. Ransome, L. H. Huddart, E. F. Merchant, F. J. Owens, A. E. Burd, J. B. Duff, and F. Bushell. Second year: F. E. Armstrong, W. E. Porter, and H. W. Wilson. Third year: W. Bayliss. Machine design—First year: E. F. Merchant and F. J. Owens. Second year: A. Thomas and J. C. W. Humfrey. Third year: W. Bayliss and H. H. Johnson. Graphic Statics—First year: E. F. Merchant, L. G. Pearson, C. A. Cooke, B. Stallybrass, E. J. Dod, A. E. Burd, L. H. L. Huddart, and E. Quiggin. Junior Surveying—F. E. Armstrong. The following students have succeeded in gaining the prizes for practical work:—First year: F. J. Owens, first prize; E. F. Merchant, second prize. Second year, A. Thomas, first prize; and J. C. W. Humfrey, second prize. Third year: W. M'Gregor Ross, first prize. The University results were next gone through. It was pointed out that again this year the engineering department had secured a very high position in competition with the sister colleges of Manchester and Leeds; and that, again, as on the two previous years, a Liverpool student had been placed in the highest possible position. It was the greatest satisfaction to him that this honour rested with the son of the director of technical instruction, who was with them at the meeting. Mr. Morrow, whose father was so well known in connection with the School of Science, had obtained his M.Sc. degree, and his valued colleague in the engineering department, Mr. Stanton, had been granted the highest distinction in the University, that of D.Sc. These were the first two students who had been granted this degree in engineering since the foundation of the Victoria University. The award of the 1851 Research Scholarship had been made to Mr. E. Brown, B.Sc., another student of the engineering department. The report then went on to allude to the work of the College Engineering Society, the following papers having been read during the session:—"Flow of Water," Professor Hele-Shaw; "Construction from the Architect's Point of View," by Mr. A. Stratton; "Retrospect of Steam Navigation," by Mr. A. J. Maginnis; "Wood-cutting Machinery," by J. H. Harrison; "Recent Excavations at Carthage," by Professor H. A. Strong; "Timber: its Lines of Weakness and Strength," by Mr. Mr. C. E. Jones; "Carborundum: its Manufacture and Properties," by Dr. C. A. Kohn; "Water Supply," by Mr. T. Duncanson. The excursions made by the students this year include North Shore Flour Mills, Eastman's, Limited, Cold Storage, Cunard Steamship Engine Works and Etruria, the Salvage Association, Bootle Fire Station, Hatton Garden Fire Station, Corporation Electric Generating Station, Refuse Destructor, Pumping and Ventilating Station of the Mersey Railway, Generating Station of Overhead Railway, *Mercury* Printing-offices, *Daily Post* and *Echo* Offices, and various places of interest on the Mersey Dock Estate, including the pumping station, Langton Dock, dredger, and the new tobacco warehouse, Stanley Dock. The heartiest thanks of the Engineering Department were due to all those gentlemen who had so kindly offered facilities for those visits.

A vote of thanks was passed in favour of the chairman, on the proposition of Mr. W. Hewitt, who called attention to the great stir which is now being made in the educational world—on the previous day in connection with elementary education, and that day in connection with technical education, when the foundation stone of the new building was being laid, and the highest of all, the University work at the present meeting.

The Dean of the Medical Faculty seconded this vote, and mentioned the importance of the introduction of the examination in connection with admission to the Institution of Civil Engineers, such examinational requirements having long been necessary in the other learned professions.

## EMIGRATION.

THE July circulars of the Emigrants' Information-office, 31, Broadway, Westminster, S.W., and the annual editions of the penny hand-books, show the present prospects of emigration. There is a good opening for experienced farm hands in Canada at this season of the year; but the demand for mechanics is small. Only strong experienced miners or men accustomed to prospecting for minerals in wild and unsettled countries, and having at least £300 for journey and food, should think of going to the Klondike goldfields; all others are strongly warned against going there. The local superintendent of police reports this year that hundreds of claims will be offered for sale on the outside markets, which will be totally valueless. A recent memorandum of the Local Government Board requires that Boards of Guardians sending out children to Canada should make an additional payment varying from £1 4s. 8d. to £10 14s. 9d. per child to provide for its annual inspection in Canada till it is sixteen years of age.

There is no great demand for more labour at the present time in New South Wales, but it is stated that at Sydney tailoresses can always get work, and a few first-class lithographers would find employment at £3 to £4 a week; men in the metal trades are fairly well employed. There is no opening for railway men from outside the Colony. The total acreage under cultivation this year is considerably more than in 1897. A serious dispute has arisen between colliery proprietors and their men on the coal-weighing question; it is possible that all the coal mines may be shut down, unless the mining law be amended or some agreement be arrived at.

In Victoria the yield of gold continues to increase. There is no general demand for more labour; but there are excellent openings for men who understand fruit growing, and for miners experienced in prospecting new country.

In South Australia there is no demand for more hands, either in town or country districts.

As regards Queensland, reports from Brisbane, Maryborough, Bundaberg, Mackay, and other parts show that there is practically no demand for more mechanics; there is, however, a good demand for farm labourers in sugar districts during the crushing season, but it must be remembered that this only lasts from June to December.

In Western Australia—with the exception of the town of Coolgardie, where the labour supply is ample—there is a good demand for mechanics, miners, general labourers, farm labourers, and female domestic servants. A considerable number of free homesteads are being taken up by settlers.

In Tasmania there is little demand for more mechanics or farm labourers; but the mining industry on the West Coast is developing, and is giving increased employment to miners and workmen of all kinds. Extensive smelters are being put up at Zeehan, and brickfields have recently been opened.

In New Zealand plenty of work has been offering in the building trade, and in most other trades; but with some few exceptions the local supply of labour seems to be sufficient. For experienced farmers with capital, and for skilled mechanics with sufficient money to keep them for a time, and for domestic servants, there are excellent openings in this Colony.

In Cape Colony the protracted droughts have at length broken up, and the scourge of rinderpest has been to a considerable extent held in check. Prospects therefore are generally improving, and marked progress has been made in developing the important industry of fruit growing. The building trade has been very active of late at Cape Town, and there is said to be some demand for carpenters and masons at Grahamstown. Speaking generally, however, there is at the present time no demand for anyone in the Colony except in some parts for thoroughly skilled mechanics; inexperienced hands will find great difficulty in getting work.

In Natal there is very little demand for more mechanics, and coloured labour is almost exclusively employed on farms.

ELECTRIC LIGHTING AT BALMORAL CASTLE.—The arrangements for lighting Balmoral Castle by electricity are now being carried into effect, and during her Majesty's recent stay there considerable progress was made with the estate work in connection therewith. Half a mile of iron pipes of large diameter has been laid for bringing the water from the upper portion of the Gelderburn to the site of the turbine house, which is situated near the old sawmill, about a mile and a-quarter from the Castle. In some places ways 12ft. deep had to be blasted through the rock for laying the pipes. Provision is being made for two Gilkes vortex turbines, which, with a fall of nearly 80ft., will give 80-horse power combined. This power will be utilised in driving the dynamos for charging a large battery of accumulators at the Castle, and also for lighting the lamps direct. The current will be transmitted by large cables laid underground all the way. According to the *Times*, the electric light will at first be limited to the Queen's private apartments, the ball-room, and a few of the principal rooms in the Castle, and the installation is expected to be in working order by the time her Majesty returns to the North next month. Eventually more than 600 lights will be installed in the Castle alone; but if electric lighting is extended to the stables and outbuildings, about 1000 lights will be required. The whole of the work, with the exception of fixing the turbines, is being carried out by the commissioners' staff at Balmoral, assisted by some of the household electricians, under the direction of Mr. William Massey, of Twyford.

## THE PATENT JOURNAL.

*Condensed from "The Illustrated Official Journal of Patents."*

### Application for Letters Patent.

*** When inventions have been "communicated" the name and address of the communicating party are printed in italics.

*25th June*, 1898.

14,053. BRACES, H. F. Gordon, London.
14,054. PUZZLES, R. A. Dunt, London.
14,055. LOOM MOTIONS, J. Highton, Castleton, near Manchester.
14,056. SAFETY of LADDERS, J. T. Adshead, Rochdale.
14,057. HOOKS, G. Cranmer, Birmingham.
14,058. OPERATING ELECTRIC RAILWAYS, C. Pollak, London.
14,059. PRODUCING RADIATION by ELECTRICITY, C. H. Stearn and C. F. Topham, Kew Gardens, Surrey.
14,060. SWELLS of LOOMS, R. Scott, Dundee.
14,061. WHIP SOCKET MOUNT PROTECTOR, W. Standen, Charlbury, Oxon.
14,062. GARDEN IMPLEMENT, W. Sparrow, Manchester.
14,063. ARTICULATORS, W. and A. L. Stringfield, Lowestoft.
14,064. VELOCIPEDE FRAMES, G. Pilkington, Coventry.
14,065. CONNECTING ENDS of CHAINS, J. W. Robathan, Birmingham.
14,066. REPAIRING HOOKS, J. W. and S. J. Carder, London.
14,067. SHOES, J. N., W. C., R. J., and C. Pringle, London.
14,068. MILKING APPARATUS, O. R. Hauskey, London.
14,069. SCREENS, S. C. Hart, London.
14,070. WATCH HOLDERS, W. R. Lake.—(*The Ansonia Brass and Copper Company, United States.*)
14,071. GOVERNORS, W. R. Lake.—(*The Æolian Company, United States.*)
14,072. CYCLE FRAMES, J. Hughes and J. M. Dixon, London.
14,073. VEHICLES, O. Georgi, London.
14,074. PUZZLE, W. H. Lister, London.
14,075. STOVES, W. E. Jefferies and A. Champion, London.
14,076. MATTRESSES, H. Schiffer, London.
14,077. DYNAMO BRUSH, C. F. Kirchhoff, London.
14,078. METHOD of ADVERTISING, W. English, Manchester.
14,079. MEANS for DRYING CYLINDERS, G. Ormerod, Manchester.
14,080. BEARING for BRIDGES, W. G. Watts, Tipton, Staffordshire.
14,081. CYCLE DUST PREVENTER, D. Llewellyn, Newport, Mon.
14,082. POLISHING CLOTH, F. D. Haddon, Manchester.
14,083. OVEN-HEATING FURNACES, W. Halliman, Stockton-on-Tees.
14,084. SECURING BRUSH HEADS to HANDLES, H. Newton, Derby.
14,085. DRIVING GEAR for BICYCLES, F. T. Fletcher, Derby.
14,086. VALVES, W. and T. W. Lees, Halifax.
14,087. CYCLE BRAKE, H. Brownhill, Birmingham.
14,088. EYEGLASSES, W. G. Heys.—(*E. Berger, France.*)
14,089. STONE CLEANER, M. W., E. A., and A. Alcock, Didsbury, near Manchester.
14,090. HOISTS, F. H. Royce and E. A. Claremont, Manchester.
14,091. MEASURING FUNNELS, S. Ellsch, Halifax.
14,092. APPLICATION of YARN, W. Newing and J. H. Smith, London.
14,093. LACE NETS, A. E. Farmer and W. E. Dowson, London.
14,094. STEAM PUMPING ENGINES, J. C. Hudson, London.
14,095. DRAUGHT PREVENTER, C. A. Park and W. H. S. Craven, Manchester.
14,096. FIRE-ARMS, J. W. Mackenzie.—(*G. L. Putnam and C. H. Farmer, United States.*)
14,097. BUTTON, A. Laussmann and H. Franzke, London.
14,098. LOOM LAG, S. E. and A. Priestley and M. Hirst, Liversedge.
14,099. CLOSETS, E. A. Reisig, London.
14,100. SIGNALLING APPARATUS, The British Thomson-Houston Company, Limited.—(*B. A. Fiske, United States.*)
14,101. SURFACE CONTACT SYSTEMS, The British Thomson-Houston Company, Limited.—(*W. B. Potter, United States.*)
14,102. TOBACCO PIPES, S. Oppenheimer.—(*G. Grandclément, France.*)
14,103. LEVEL, G. Krapp, London.
14,104. ROTARY ENGINES, W. J. Calder, Stellenbosh, South Africa.
14,105. BUTTONS, J. Wells, Birmingham.
14,106. COLLAPSIBLE FRAME for TENTS, W. H. Myers, London.
14,107. METERS, F. M. Long and E. Schattner, London.
14,108. HEATING FURNACE, J. H. Lones and J. Lewis, London.
14,109. BLINDS, A. C. Downing, London.
14,110. PIANOFORTES, D. Makinson, London.
14,111. WARP GUIDE, W. Runton and G. Thompson, London.
14,112. BATTERIES, A. Peters, London.
14,113. DISTRIBUTION of ELECTRICITY, H. A. Wagner, London.
14,114. VEHICLE-PROPELLING APPARATUS, C. W. Thompson, London.
14,115. VELOCIPEDE FRAMES, H. Moore and P. L. Renouf, London.
14,116. VEHICLES, W. Griffiths and W. C. McEwen, Glasgow.
14,117. MOTORS OPERATED by FLUID, C. Campus, London.
14,118. BICYCLING LAMPS, J. E. L. Wright-Ashworth, Liverpool.
14,119. TREATMENT of DECAYED VEGETABLE MATTER, W. T. McGarty, Machester.
14,120. VALVE, A. Priest, London.
14,121. HIGH-WATER INDICATOR, R. C. G. Staats and W. Coates, Old Brompton, Kent.
14,122. SPRING and BRAKE HAMMERS, A. Oldbury, London.
14,123. DRAWING PEN, H. Lister, London.
14,124. DRUMS for ELECTRIC CABLES, W. B. Brown, London.
14,125. ELECTRO THERMIC INCUBATOR, A. E. Greville, London.
14,126. WHIPS, A. C. Upton, London.
14,127. UTILISING RADIANT HEAT, H. J. Dowsing, London.
14,128. WAR VESSELS, H. Maxim, London.
14,129. INFLATING PNEUMATIC TIRES, H. N. Abell, London.
14,130. APPARATUS for RECREATION, W. Stenning, London.
14,131. PREVENTING BACK DRAUGHT, C. D. Abel.—(*Stassfurter Chemische Fabrik cormals Vorster und Grünebery Actien Gesellschaft, Germany.*)
14,132. ELECTRICAL FURNACES, W. L. Durban and J. Gore, London.
14,133. FLOAT FEED APPARATUS, E. B. Caird and T. J. Rayner, London.
14,134. DISTRIBUTING TYPES and MATRICES, E. Wentscher, London.
14,135. INCANDESCENT GAS BURNERS, J. Dymond, London.
14,136. REPLY POSTCARD, E. H. Burrage, Earlswood.
14,137. TREATING ORES, S. O. Cowper-Coles, London.
14,138. SEWING MACHINES, W. R. Lake.—(*M. Bray, United States.*)
14,139. ACETYLENE GAS, Sir C. S. Forbes, Bart., London.
14,140. ADHESIVE STAMP, W. R. Lake.—(*La Société Anonyme des Imprimeries Lemercier, France.*)
14,141. TORPEDO LAUNCHING APPARATUS, S. Drzewiecki, London.
14,142. COUPLING DEVICES, A. Jourdan and F. Kahn, London.

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14,143. TOY for THROWING CARDS, A. J. Parsons and A. Morritt, London.
14,144. GENERATING ACETYLENE GAS, F. B. Parkinson, Cheltenham.
14,145. CADDIE BAGS, A. J. Hayward, Woodbridge, Suffolk.
14,146. RAILWAY CORNICE POLE, G. H. C. Butler, Birmingham.
14,147. PACKING BOTTLES, J. Smith, Glasgow.
14,148. SHUTTLE GUARDS for MACHINERY, A. Shaw, Haslington, Lancashire.
14,149. LAMP, W. W. Lewis, S. J. Davis, and F. J. Osmond, Birmingham.
14,150. NOVELTY INTENDED as a CALENDAR, G. Tuck, London.
14,151. TIME FUSES for PROJECTILES, H. V. Keeson, London.
14,152. SCAFFOLD, M. Polhill, London.
14,153. DISCHARGING GRAIN, S. Hulme, Glasgow.
14,154. PUZZLE, G. Brown, London.
14,155. PUZZLE, G. Brown, London.
14,156. PUZZLE, G. Brown, London.
14,157. APPLYING LUBRICANT, P. Smith and S. Ambler, London.
14,158. RELEASE GEAR for BICYCLES, H. J. Yieldham, Sutton, Surrey.
14,159. SEWING MACHINES, J. Knox, Manchester.
14,160. FISHING ROD, W. Baker and Waycot, Paignton, Devon.
14,161. WOODEN CLUB, J. Hunter, Muir Brechin, Forfarshire, N.B.
14,162. TREATMENT of SEWAGE, C. J. Wittaker and W. C. Bryant, Liverpool.
14,163. INKSTANDS, T. A. Langhorno, Silsden, near Keighley.
14,164. RIM BRAKE for BICYCLES, C. G. Cooper and The Cooper Twin-lever Cycle Brake Company, Limited, Bristol.
14,165. CUTTING COAL, T. Wrightson and J. Morison, Stockton-on-Tees.
14,166. TOBACCO PIPES, E. A. C. Endsleigh, Knutsford, Cheshire.
14,167. SMOKING PIPE, H. Andrews, Margate.
14,168. BEDSTEAD, A. E. Davis, Acocks Green, near Birmingham.
14,169. GOLF CLUB, R. L. Cowper-Coles, and R. S. C. Peake, Wolverhampton.
14,170. TREATING SPLIT SKINS, J. Eaton, Stockport.
14,171. CUTTING SAWN LENGTHS of TIMBER, A. Chivers, London.
14,172. UPSET for USE in OVENS, F. J. Bingham, London.
14,173. SPRING TOY SURPRISE, C. Bontempo, London
14,174. GAME, B. B. Kingsford, London.
14,175. MATCHES, W. G. Cordes, London.
14,176. WATER BATHS, W. and P. Pfleiderer, London.
14,177. HUBS for VELOCIPEDE WHEELS, P. L. Renouf, London.
14,178. BOILERS, T. Messenger and A. A. Whitlock, London.
14,179. BALLOON, J. X. Dusséqué, London.
14,180. BRICKS, S. J. Payne, F. S. Taylor, and J. J. Edwards, London.
14,181. LUBRICATING APPARATUS, J. Hochgesand, London.
14,182. APPARATUS for CRUSHING ORE, C. F. B. Tainton, London.
14,183. PIANOS, W. S. Simpson, London.
14,184. IMPREGNATING INCANDESCENT MANTLES, A. E. Stamm, London.
14,185. DETECTING PUNCTURES, G. J. G. Jensen and G. H. Congdon, London.
14,186. DRIVING GEAR for BOATS, W. Bettis, West Ham, Essex.
14,187. MOULDING ARTIFICIAL STONES, G. Leicht, London.
14,188. DURABILITY of BOOTS, F. H. Davis, London.
14,189. MOULDING FORMS of PATTERNS, A. G. Hopper, London.
14,190. FEED HOPPERS for MEAL GRAIN, T. Ashley, jun., W. H. Owen, and T. H. Motley, London.
14,191. BASKETS, J. Imray.—(*J. Moeller, France.*)
14,192. SELF-OILING PULLEYS, F. H. Spear, London.
14,193. WAITING TRAY, J. J. Marshall, London.
14,194. LATHES, J. H. Weiss.—(*W. P. Preble, United States.*)
14,195. SEWING MACHINE SPOOL HOLDER, D. W. Cottin, London.
14,196. GENERATORS for ACETYLENE GAS, W. R. Smith, London.
14,197. PRODUCING ACETYLENE, W. P. Thompson.—(*H. Sez, France.*)
14,198. PRACTISING GOLF, W. P. Thompson.—(*S. W. Bates, United States.*)
14,199. AMMONIA, T. Cryer, Manchester.
14,200. PERPETUAL CALENDARS, F. Fassbender, London.
14,201. LOCKS, S. Houser, J. T. Rountree, and G. F. Musser, Liverpool.
14,202. CLEANING TEXTILE GOODS, E. F. Kur.—(*M. Bochler, Germany.*)
14,203. INCREASING BICYCLE SPEEDS, G. J. Dolliner, London.
14,204. ELECTRIC BATTERIES, M. M. Bair, London.
14,205. PREPARING PLATES for PRINTING, J. H. Smith, London.
14,206. VAPOUR MOTORS, G. C. Marks.—(*C. Tornero, France.*)
14,207. GREAT CIRCLE COURSE INDICATOR, S. R. Kirby, London.
14,208. MAIL-BAG FASTENINGS, F. de L. Hudson.—(*R. H. Eastown, New South Wales.*)
14,209. CRUSHING QUARTZ, J. Colquhoun-Thomson, London.
14,210. PRODUCING ACETYLENE, A. J. Boult.—(*Suret et Cie., France.*)
14,211. EXCITANT SOLUTIONS for BATTERIES, A. J. Ward, London.
14,212. TRANSMITTER for TELEPHONES, F. A. Ray, London.
14,213. DYNAMO MACHINERY, W. Langdon-Davies, London.
14,214. BOOTS, F. J. Stohwasser and G. D. Winter, London.
14,215. CANDLES, E. Philpott, London.
14,216. ROTARY ENGINES, J. Y. Johnson.—(*M. J. Bretherton and C. H. Silliman, United States.*)
14,217. ELECTRIC LAMPS for MINERS, W. O. Wood, London.
14,218. COMBINED LAMP-POST and HYDRANT, W. Evans, Swansea.
14,219. MATCH BOX, P. S. Pithapuram, Godavari Dt., Madras Presidency, India.
14,220. TANNING HIDES, G. D. Burton, Boston, Mass., United States.
14,221. UNHAIRING SKINS, G. D. Burton, Boston, Mass., United States.

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14,222. SAW GUARDS, E. Cory and F. W. Reynolds, London.
14,223. BRAKES, W. A McCurd and H. L. Tayler, London.
14,224. JEWELLERY, E. Mojon and J. Manger, London.
14,225. VARYING the LOAD of GAS GOVERNORS, W. Cowan, Edinburgh.
14,226. APPARATUS for DRYING WOOL, J. Fielden, Rochdale.
14,227. PRINTING on BRITTLE ARTICLES, G. G. P. Wilson and W. Scott, Glasgow.
14,228. SEPARATING OIL from WATER, W. Hinchcliffe, Halifax.
14,229. THRUST BLOCKS, J. Pearce, London.
14,230. METHOD of CLOSING BOTTLES, J. Kennedy, Glasgow.
14,231. BILLIARD MARKER, J. B. W. F. White and J. A. Hunt, London.

14,232. GEAR for DRIVING CYCLES, A. A. Manbré, Liverpool.
14,233. PRINTERS' GUILLOTINES, I. R. Cauthery and T. Morton, Bradford.
14,234. ADDING MACHINE, G. C. McLaren, Glasgow.
14,235. ALUMINIUM ALLOY, W. Robertson and G. Low, Glasgow.
14,236. METHOD of PROPELLING CYCLES, R. I. Douglas, London.
14,237. ELECTRICAL SAFETY FUSE, C. J. Cooper, Bournemouth.
14,238. BOILERS, W. Lede, Liverpool.
14,239. PLANE IRONS, A. Fieldsend, Sheffield.
14,240. CHARCOAL, J. W. Dougal, Glasgow.
14,241. ENGINES, S. Bouton, London.
14,242. STEAM GENERATORS, A. Lefargue, London.
14,243. HERB INFUSER, R. Boyd, Galashiels, N.B.
14,244. GAMES, H. Esam, Tunbridge Wells.
14,245. GENERATING ELECTRICITY, F. C. Southard, Southampton.
14,246. MATERIAL-DRYING APPLIANCE, H. Winckler, London.
14,247. CRADLES for BUILDERS' PURPOSES, F. Knoeferl, London.
14,248. LOCK, S. Wharton, Birmingham.
14,249. SADDLES, J. T. Jones and H. W. Woodward, Birmingham.
14,250. STAMP MILLS, W. E. Simpson, London.
14,251. DYES, J. Y. Johnson.—(*The Badische Anilin and Soda Fabrik, Germany.*)
14,252. PRODUCTION of AZO-COLOURING MATTERS, J. Y. Johnson.—(*The Badische Anilin and Soda Fabrik, Germany.*)
14,253. PRODUCTION of AZO-COLOURING MATTERS, J. Y. Johnson.—(*The Badische Anilin and Soda Fabrik, Germany.*)
14,254. MUFF LININGS, M. Maguire, Windsor.
14,255. ELECTRIC TELEPHONY, C. Adams-Randall, London.
14,256. SCREW-CUTTING DIE HEAD, K. Mitchke, London.
14,257. REFRIGERATING MACHINE, F. Allen, London.
14,258. KNITTING MACHINE, H. Birkbeck.—(*J. Koyzer, United States.*)
14,259. EXPLOSION ENGINES, P. M. Justice.—(*The Pope Manufacturing Company (Incorporated), United States.*)
14,260. FABRIC, W. J. Brooks, London.
14,261. LIFE JACKET, F. B. Jeffery, Southsea.
14,262. VALVES for FOUNTAIN PENS, J. Byrom, Liverpool.
14,263. TROUSER SUSPENDERS, F. Hay and C. White, London.
14,264. CYCLES, F. Crundall, London.
14,265. VALVES, C. P. Kinnell, London.
14,266. RAILWAY SIGNALLING APPARATUS, G. W. Hutt, London.
14,267. BRAKES, W. M. White, London.
14,268. BUTTON-HOLE SEWING MACHINES, W. M. House, London.
14,269. ALKALIES, C. E. Acker, London.
14,270. DRAWING OFF WOOL from COMBS, A. Long and R. Foster, London.
14,271. TURNING MACHINES, H. H. Lake.—(*S. Ross, United States.*)
14,272. WEIGHING MACHINE, F. H. Richards, London.
14,273. WHEELS, E. E. Powers, London.
14,274. METALLIC PACKING for PISTONS, C. Lockwood, London.
14,275. JOINTING of METAL PIPES, R. Ewing, London.
14,276. PNEUMATIC CYCLE SADDLES, F. G. Potter, London.
14,277. VELOCIPEDES, W. Hillman, London.
14,278. WHEEL AXLES, H. Ehrhardt, London.
14,279. SIGNALLING DEVICE, A. Lorz, London.
14,280. PREVENTING CHEQUE FALSIFICATION, E. Edwards.—(*R. Candriani, Germany.*)
14,281. TRAMWAYS, G. F. Deacon, London.
14,282. LATCHES, D. Waine, Birmingham.
14,283. BRICKS, W. P. Thompson.—(*F. C. Norris, United States.*)
14,284. ENGINES, W. P. Thompson.—(*T. H. Hicks, T. S. White, and T. Friant, United States.*)
14,285. GENERATING GAS, W. P. Thompson.—(*R. M. Snyder, United States.*)
14,286. LUBRICATORS, W. P. Thompson.—(*G. Beisbarth vorma's F. Loos, Germany.*)
14,287. CLEANING CYCLE TIRES, H. Wittrock, London.
14,288. HOLDER for VELOCIPEDES, F. H. W. Breininger, Birmingham.
14,289. STREET SWEEPERS or CLEANERS, E. J. Smith, Liverpool.
14,290. WRENCHES, G. R. van Schoick and F. W. Stewart, Liverpool.
14,291. TICKETS for MARKING GOODS, W. Jones, Liverpool.
14,292. COCKS, P. Leonard, Liverpool.
14,293. SYSTEMS of ELECTRICAL DISTRIBUTION, R. Belfield. —(*C. F. Scott and B. G. Lamme, United States.*)
14,294. REGULATION of TRANSFORMER, B. G. Lamme, London.
14,295. GAS-ENRICHING APPARATUS, C. S. Forbes, London.
14,296. TRICYCLES, Marriotts', Limited, and J. D. Spencer, London.
14,297. RADIATORS, M. M. Brophy, London.
14,298. DRILLS, R. Binnie, London.
14,299. INTRODUCER made of BENT WIRE, F. May, London.
14,300. ROUNDING the RIMS of WHEELS, W. Deiwiks, London.
14,301. FIRE-PLACES, C. Baverez, London.
14,302. BRAZING, W. R. Bowers, London.
14,303. PUBLIC LAMP STANDARDS, H. M. Robinson, London.
14,304. PROTECTING WALLS from MOISTURE, C. Fleisch, London.
14,305. BREWING, F. Faulkner and J. E. J. Johnson, London.
14,306. RELAYS, E. A. F. Arnaud and C. A. A. Gantès, London.
14,307. PRODUCING OZONE, E. Böhm, London.

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14,308. DRYING CLOSETS, E. Williamson and C. Hammerton, London.
14,309. CULTIVATOR, W. T. Sharpe, Virginia Water, Surrey.
14,310. KEYS, H. F. Pattinson, London.
14,311. BOOTS, J. Kennell, London.
14,312. COVERING for CRICKET PITCH, H. J. Steavenson, London.
14,313. SAFETY TRAVELLING BASKET, H. J. Steavenson, London.
14,314. SPRINKLER, A. J. Davis, Ashford, Kent.
14,315. MOTOR CARRIAGES, E. Henriquez, Manchester.
14,316. BATTERIES, A. E. J. Ball, West Hooe, near Plymouth.
14,317. PHOTOGRAPHIC CAMERAS, J. D. McKellen, Manchester.
14,318. DYNAMO ELECTRIC MACHINES, S. G. Brown, Bournemouth.
14,319. TROUSER STRETCHERS. A. Doman, Dudley.
14,320. AIR-DISINFECTING APPLIANCES, W. L. Clark, Hull.
14,321. CYCLE RESTS, C. E. Corbitt, Manchester.
14,322. PRINTING on BOOK EDGES, N. McPhail, Glasgow.
14,323. LOCK, S. M. R. Heron, Downpatrick.
14,324. CARRYING OVEN SHELVES, C. E. Trickett, Sheffield.
14,325. PULLEY WHEEL FRAME, H. Harper, Birmingham.
14,326. VELOCIPEDES, C. W. Hathaway and The Triumph Cycle Company, Limited, Coventry.
14,327. TABLES, J. J. Boyd, Newcastle-on-Tyne.
14,328. MUD-LIFTER and BRUSH-HANGER, S. A. Greene, Winchester.
14,329. SADDLES, E. Birch, Manchester.
14,330. CLUBS, J. C. Adamson, Glasgow.
14,331. DIFFUSER of ELECTRIC LIGHT, S. T. White, Bristol.
14,332. WINDING YARN on SPOOLS, D. Campbell, Kidderminster.
14,333. GARDEN FRAMES, G. Morris, Nottingham.
14,334. OILS, J. Lewkowitsch, Manchester.
14,335. CYCLISTS' TROUSER GUARD, R. A. W. Earl, Cardiff.
14,336. A ROOT CLEANER, W. R. Ladkin, Rugby.
14,337. HEEL CLIP PEDAL for CYCLES, A. Brash, Dublin.
14,338. RECORDING RAILWAY SIGNALS, R. Slack, Manchester.
14,339. STEAM BOILERS, G. N. Berwick, London.
14,340. ENVELOPES, A. W. Drayson, London.
14,341. PRICE TICKETS, C. A. Christy, London.
14,342. PICKAXES, M. Ditchburn and T. Whitehead, London.
14,343. HEAD COVERINGS, R. Wakely, London.
14,344. WATER-COOLED FIRE-BARS, E. J. Koester, London.
14,345. BREECH-LOADING FIRE-ARMS, G. Hughes.—(*J. D. Koon, United States.*)
14,346. FASTENINGS for COLLAR STUDS, E. Browne, London.
14,347. HANDLE BARS of CYCLES, &c., W. H. Lister, London.
14,348. AXLE CAPS of CARRIAGE WHEELS, J. Day and A. and C. E. Timewell, London.
14,349. FENDERS, B. Addicott and G. Holland, Birmingham.
14,350. CYCLE PEDAL CRANKS, W. Bishop, London.
14,351. SUPPORTING INSTEP ARCH, F. H. Davies, London.
14,352. PROPULSION of VEHICLES, E. Francis and P. Angois, Nottingham.
14,353. BOBBINS for BRAIDING MACHINES, O. Seydlitz, Germany.
14,354. CYCLE-DRIVING MECHANISM, S. F. Smith, Forest Gate, Essex.
14,355. LOW RESTS for BUGGYS, N. McAulay and C. Von Woehrmann, London.
14,356. OIL STOVES, E. H. Driggs, London.
14,357. MOTOR, W. J. Munden, London.
14,358. OIL FILTERS, H. P. Hess, London.
14,359. WARDROBES, A. R. Lordly, London.
14,360. DISTILLATION of HYDROCARBONS, S. Pitt.—(*The Compagnie Internationale des Procédés Adolphe Seigle, France.*)
14,361. COUPLING DYNAMOS, J. A. McMullen, London.
14,362. PENDANTS for ELECTRIC LAMPS, E. J. Shaw, London.
14,363. ELECTRIC SWITCHES, C. P. Elieson and W. S. Naylor, London.
14,364. CARBONIC ACID, H. E. Newton.—(*The Farbenfabriken vormals Friedrich Bayer and Co., Germany.*)
14,365. SHOULDER STRAPS, F. J. Stohwasser and G. B. Winter, London.
14,366. TRACE HOOKS for VEHICLES, T. Patrick, London.
14,367. THROWING the LOAD ON or OFF PUMPS, The Hydraulic Engineering Company, Limited, and W. Carter, London.
14,368. ROWLOCKS for BOATS, W. Styles, London.
14,369. PROJECTING SERIES of PICTURES, R. Krayn, London.
14,370. WOODEN FLOORING, M. Fawcett, B. A. Elphicke, and J. Hope, London.
14,371. STERN GEAR for SCREW VESSELS, Simpson, Strickland, and Co., Limited, and W. Cross, London.
14,372. EXTRACTING COAL DUST from FLUE GASES, W. Beth, London.
14,373. BAG FILTERS for SEPARATING DUST, W. Beth, London.
14,374. RESILIENT TIRES for ROAD VEHICLES, F. W. Golby.—(*S. A. Dorical, France.*)
14,375. WALLS for MINE GALLERIES, A. C. Hempel and J. H. Nuttall, London.
14,376. DRAUGHTSMEN, A. H. Brazier and A. S. Guttenberg, London.
14,377. BALLOONS, H. V. Wede, London.
14,378. PRODUCING ARTIFICIAL STONE, A. W. Perriman, London.
14,379. FEEDING BOTTLES for INFANTS, F. Kruse, London.
14,380. ELECTRIC BATTERIES, E. Giglio, Liverpool.
14,381. CYCLES, C. Lippens, Liverpool.
14,382. ANTI-CORROSIVE PUMP for FERMENTED LIQUIDS, J. A. Venn, Liverpool.
14,383. DUPLICATING EMBOSSED LITERATURE, J. G. Fisher, J. F. O'Brien, and S. R. Thompson, Manchester.
14,384. LAYING SHEETS of PAPER EVENLY, T. Chadwick, Manchester.
14,385. REELS for HOLDING YARNS, H. Schwarzenbach, London.
14,386. COKE-TRANSPORTING APPARATUS, E. N. Trump, London.
14,387. ROTARY PUMP APPARATUS, E. B. Donkin, London.
14,388. LETTER FILES, P. H. Holmes, London.
14,389. INK-WELLS, P. H. Holmes, London.
14,390. SASH LOCKS, P. H. Holmes, London.
14,391. ARTICLES of FIBROUS MATERIAL, P. H. Holmes, London.
14,392. CYCLE BAR, F. Sanders, Barnstpale, Devonshire.
14,393. KEYBOARD, P. B. W. Kershaw and H. Dundas, London.
14,394. PRODUCING SLABS for BUILDING, W. Antony, London.
14,395. RE-COVERING TUBES while BORING, T. Schulteis, London.
14,396. BALL BEARINGS, C. R. and C. G. Garrard, London.
14,397. ROAD GRIPPERS for MOTOR-CABS, C. Duncombe, London.
14,398. TREATMENT of SKINS, F. de and G. de Rechter, London.
14,399. ELECTRIC MEASURE, A. B. Blackburn and W. L. Spence, London.
14,400. FILTERING APPARATUS, T. H. Bristowe and Co., Limited, and W. R. Renshaw, London.
14,401. The "ROTA" INKWELL, G. Maidment, Bescot, near Luton.
14,402. WATER-CLOSET PAN SCREW, H. S. Foster, London.
14,403. LIFE BELT, J. F. A. Carobine, Perry Bar, Birmingham.
14,404. PYRAZINE, J. H. Taylor, St. Anne's-on-the-Sea.

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14,405. MECHANICAL MILKING APPARATUS, T. Stoltenberg London.
14,406. DRIVING CHAIN, R. Wilberley, Halesowen, Worcestershire.
14,407. FOLDING STAND for BICYCLES, A. J. Smith, Gloucester.
14,408. RAISING WINDOWS, A. Bell and J. P. Haigh, Sheffield.
14,409. DRYING MATERIALS, G. S. de Ritter, London.
14,410. CYCLE STORAGE, A. A. Wade, Leeds.
14,411. LATRINES, M. J. Adams, Leeds.
14,412. REVERSIBLE CUFF PROTECTOR, E. A. R. Matthews, Newport, Mon.
14,413. VARIABLE SPEED GEAR, T. and H. Geering, Rolvenden, Kent.
14,414. ADJUSTABLE PRESSING ROLLER, W. H. Heys and J. T. Hewitson, Monkwearmouth.
14,415. PERFORATED WATCH POCKET, M. E. Redhead, Coniston, R.S.O., Lancashire.
14,416. UTILISING POCKET-KNIVES, H. J. F. Crane and P. F. Butterfield, London.
14,417. SECURING PIVOTED SASHES of WINDOWS, S. Hughes, London.
14,418. SUPPORTING BLACKBOARDS on EASELS, J. E. Blackledge, Manchester.
14,419. WATER-TUBE BOILER, A. B. Collis, Southampton.
14,420. THREAD OPENER, W. E., W. H., and H. E. Aykroyd, Bradford.
14,421. DYEING of YARN, W. E., W. H., and H. E. Aykroyd, Bradford.
14,422. DOOR STOP, F. Heywood, Manchester.
14,423. INFLATORS for PNEUMATIC TIRES, W. Lowe and H. and E. Britton, Birmingham.
14,424. HAND VICES, J. Hampton, jun., Birmingham.
14,425. VELOCIPEDE WHEEL TIRES, F. Rose, Liverpool.
14,426. DRYING and HOUSING of CORN, P. McLean, Glasgow.
14,427. FILAMENT for ELECTRIC INCANDESCENT LAMPS, English Industrials, Limited, and G. E. Heyl-Dia, Manchester.
14,428. GAS and OIL ENGINES, J. G. A. Kitchen, Manchester.
14,429. HANK-SCOURING APPARATUS, T. Bentley, Bradford.
14,430. VENT PEGS and TAPS, F. and O. Tutill, Manchester.
14,431. WIRE FENCING, A. Simpson, Glasgow.
14,432. ACETYLENE GAS GENERATORS, The British Acetylene Gas Generator Company, Limited, and H. K. Spence, Glasgow.
14,433. ELECTRIC BELLS and FITTINGS, B. A. Phillipson, Dublin.
14,434. TOBACCO PIPES, J. T. Dawes, Liverpool.
14,435. PICKING SHAFTS of LOOMS, A. Wood and E. Nightingale, Manchester.
14,436. SPECTACLE CASES, S. J. Carey, Birmingham.
14,437. CASE for CLINICAL THERMOMETERS, A. F. Blagdon-Richards, Swansea.
14,438. CHARGING COAL GAS RETORTS, S. J. Ingram, Truro.
14,439. ARRESTING the MOTION of GILL-BOXES, A. Mitchell, Keighley.
14,440. NOBLE'S COMBS, R. Clough and Co., and S. G. Broadbent, Manningham, near Bradford.
14,441. BORING HOLES, C. Hucier and W. Prügel, London.
14,442. SEA FISHING, R. Crabtree, London.
14,443. FLANGING the ENDS of FURNACE FLUES, J. I. Booker, Leeds
14,444. MAKING PAPER BAGS, J. and M. Macintyre, Glasgow.
14,445. CYCLES, F. Beauchamp, London.
14,446. CIGARETTE-MAKING MACHINES, A. J. Boult.—(*O. Bergstraesser, Germany.*)
14,447. LOUVRE VENTILATOR, G. Baader, London.
14,448. CYCLE FRAMES, F. Ritchie, London.
14,449. SAFETY BOLT, J. Haag, London.
14,450. PRODUCING OZONE, E. Böhm, London.
14,451. SCREW-STOPPERS for BOTTLES, W. G. Davies, London.
14,452. TREATING WINES, J. E. Carroll, London.
14,453. CALCIUM CARBIDE, J. E. T. Woods and W. A. Byrom, London.
14,454. INCANDESCENT GAS BURNERS. A. J. Boult.—(*G. Delin, Belgium.*)
14,455. SECONDARY BATTERIES, T. A. B. Carver, London.
14,456. DETACHABLE SOUP SPOON CAP, A. W. Robinson, Twickenham.
14,457. STOPPERS for BOTTLES, C. R. G. Hövermann, London.
14,458. MIXING INGREDIENTS for SAUCES, A. E. Young.—(*L. H. Crest, United States.*)
14,459. BEDSTEADS, F. J. Middleton and W. Molineaux, Birmingham.
14,460. JOINT for CORNICE POLES, A. E. Collins, London.
14,461. GEARING, H. Crone and C. Rucher, London.
14,462. CHAMBERS for DRYING SHERRY, G. L. Anderson, London.
14,463. INCANDESCENT GAS LIGHTING, P. G. de Schodt, London.
14,464. INDIA-RUBBER TIRES, W. E. Bartlett, London.
14,465. PRODUCTION of METHYL-MORPHINE, A. Ehrenberg, London.
14,466. PNEUMATIC TIRES, H. E. Smith, London.
14,467. METALS, F. W. Carlton and H. J. Phillips, London.
14,468. DYES, P. C. Bunn, London.
14,469. PHOTOVISIOGRAPHS, L. H. Cohen, London.
14,470. GUN CARRIAGES, G. F. Redfern.—(*E. Ternström and P. Nordvafelt, France.*)
14,471. MANUFACTURE of WHEELS, J. W. Holst, London.
14,472. MANUFACTURE of TEXTILE FABRICS, S. Pitt.—(*L. Cusella and Co., Germany.*)
14,473. NEW LITERARY GAME, J. O. Pelton, London.
14,474. GRINDING STOPPERS for VESSELS, J. Fliegel, London.
14,475. PREPARING FIBRES for ROPE-MAKING, C. S. McConnan, Liverpool.
14,476. GAS STOVES, J. Titchett, Manchester.
14,477. DRAWING COMPASS, A. Smith, Birmingham.
14,478. WOODEN SPOOLS, J. Chlebowski, London.
14,479. SASH-FASTENING DEVICES, J. Shettle, Liverpool.
14,480. SEWING MACHINES, J. Cassels, Manchester.
14,481. CHARGE for use in SELTZOGENES, J. J. Spears, Birmingham.
14,482. MATCH-BOXES, G. Engel, Liverpool.
14,483. PRODUCING ANIMATED PHOTOGRAPHS, A. F. Spooner.—(*J. Duboulos and The Société Demaria Frères, France.*)
14,484. CHANGING SHUTTLES in LOOMS, F. Wächtler, London.
14,485. ACETYLENE LAMP, H. H. Lake.—(*L. des Essards, née Pinaud, France.*)
14,486. CARBURETTERS, H. E. Casgrain, London.
14,487. HANDLE-BARS, H. Belcher and F. Eason, London.
14,488. APPARATUS for DISTILLING WATER, J. T. Waine, London.
14,489. PENHOLDER, H. A. Joe, London.

*1st July*, 1898.

14,490. COUPLINGS, J. E. A. Gwynne and D. W. Porteous, London.
14,491. FURNACE GRATE, F. van der Gucht, London.
14,492. CONNECTIONS for SANITARY APPLIANCES, M. J. Adams, Leeds.
14,493. FURNITURE BUFFER, E. Haag and E. Becker, Baden, Germany.
14,494. AIR-PROPELLING APPARATUS, J. T. Cope, Birmingham.
14,495. FRICTION CLUTCHES, R. Thornley, Manchester.
14,496. COUPLING PIPES, W. Jones, Wolverhampton.
14,497. NIPPLES for ATTACHING to CYCLE SPOKES, J. Hayes, London.
14,498. SAND for MOULDS, J. Hargreaves and A. Poulson, Widnes.
14,499. FILTER-PRESSES, J. Critchlow, Stoke-on-Trent.
14,500. TIRES, J. Ridgway and H. Denton, Hanley.
14,501. CYCLE SUPPORT, A. Brock, Chertsey.
14,502. TAPS, English Industrials, Limited, and G. E. Heyl-Dia, Manchester.
14,503. DRYING TEXTILE FABRICS, G. D. Wild, Cleckheaton, Yorks.
14,504. SHUTTLES of LOOMS for WEAVING, J. Tanner, Halifax.
14,505. TURBINES, A. L. Armour, Gateshead-on-Tyne.
14,506. RATCHET GEARING for VEHICLES, R. J. Urquhart, Liverpool.
14,507. EYE-GLASSES, J. J. Wood, Liverpool.
14,508. BREAD-CUTTING MACHINES, C. Moses, Manchester.
14,509. FABRICS, J. H. McEwan and J. H. Hinchcliffe, Bradford.
14,510. CYCLE GEAR, J. O'Rell.—(*W. H. Cassell, United States.*)
14,511. OVEN, J. H. Bennett, Helsby, Cheshire.
14,512. BRACKET for BLIND ROLLERS, W. Swarbrick, Liverpool.
14,513. PRODUCING SPECTACULAR EFFECTS, C. H. Cox, Liverpool.
14,514. SWITCHBOARDS, C. H. Cox, Liverpool.
14,515. HORN HANDLES, P. Fluntke and G. Nowak, Manchester.
14,516. CYCLES, J. Robertson, Glasgow.
14,517. CYCLE LAMP, H. F. A. Schröder and M. J. Nehemias, Hamburg, Germany.
14,518. OPENING HANKS of YARN, J. S. and G. S. Lord, Manchester.
14,519. DISTRIBUTING FLUID, G. E. Ridgway, Manchester.
14,520. FORMING CURVED MORTICES, E. Frampton, Manchester.
14,521. PHONOGRAPHS, E. Mitchell, W. Whitehead, and C. Taylor, Manchester.
14,522. CYCLES, J. Fergus and J. Main, Glasgow.
14,523. FURNACE for TREATING SULPHIDES, H. R. Angel, London.
14,524. MECHANISM for SLIDING RODS, C. P. Showell, Birmingham.
14,525. TESTING ECGS, J., A., and G. Lyons, Manchester.
14,526. SAIL HANK, G. S. Munro, Clydebank, Dumbartonshire.
14,527. GOLF CLUBS, W. T. Kininmonth, Glasgow.
14,528. CYCLE STEERING LOCKS, J. W. Milligan and P. Oldfield, Birmingham.
14,529. LOOM SHUTTLE GUARD, J. Binns and A. Smith, Keighley.
14,530. UPSETTING BOILER TUBES, F. E. Wright.—(*J. R. Blakeslee, United States.*)
14,531. COOKING RANGES, A. Habershon, London.
14,532. EXTINGUISHING FIRE, L. Litynski, A. Rodakiewicz, and F. Kurowski, London.
14,533. COLOURING MATTERS, Read, Holliday, and Sons, Limited, and A. Dickson, London.
14,534. DOOR-CLOSER, H. Malet, London.
14,535. SLIDE RULES, A. J. Boult.—(*L. Rizzoli, Italy.*)
14,536. SAD IRON, W. E. Hoyt, London.
14,537. FUMIGATORS, J. T. Commoss, London.
14,538. RETAINING SUPPORT for BANDAGES, A. Seyfarth, London.
14,539. MAKING BOTTLES by MACHINERY, L. Grote, London.
14,540. REGULATING LOOMS for WEAVING, E. Herberts, London.
14,541. TRAIN-SIGNALLING APPARATUS, F. F. Farlow, London.
14,542. ATTACHING SHADES to LAMPS, J. N. Moore, London.
14,543. WIRE ROPES, H. Aitken, London.
14,544. CONCRETE FOUNDATIONS for PIERS, B. H. Jones, London.
14,545. DOUBLE-SIDE RULING MACHINE, F. W. Vickery, London.

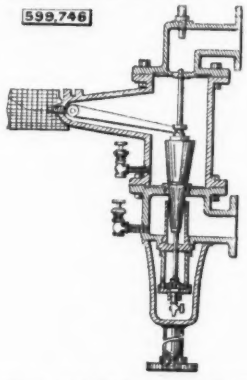
## SELECTED AMERICAN PATENTS.

*From the United States Patent-office Official Gazette.*

**599,746.** STEAM METER, *G. C. St. John, New York, N.Y.—Filed September 28th, 1896.*

*Claim.*—(1) A steam meter comprising a suitable casing provided with an ingress and an egress opening and with an internal valve seat, in combination with a paraboliform valve operating to compensate for the differential results attained by the varying heights of the lift of the valve, whereby the ratio between the flow of steam and the increase in the size of the steam space between the valve and its seat will remain constant, and registering mechanism operated by the movements of the valve, substantially as described. (2) A steam meter comprising a suitable casing provided with an ingress and an egress opening and with an internal valve seat, in combination with a valve engaging the seat, the upper portion of the valve being approximately cone-shaped and the lower portion

599,746

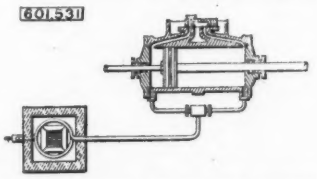


paraboliform, substantially as described. (3) A steam meter comprising a suitable casing provided with an ingress and an egress opening and with an internal valve seat, in combination with a paraboliform valve engaging the seat, and means for retarding the upward movement and for permitting free downward movement of the valve, substantially as described. (4) A steam meter comprising a suitable casing provided with an ingress and an egress opening and with an internal valve seat, in combination with a paraboliform valve engaging the seat, means for retarding the upward movement and for permitting free downward movement of the valve, and a shield for protecting the valve from the direct impact of the steam, substantially as described.

**601,531.** STEAM ENGINE, *H. Steven, San Sebastian, Spain.—Filed September, 8th, 1897.*

*Claim.*—The combination of the cylinder having ports for the admission of a heating medium, a heat-

601,531

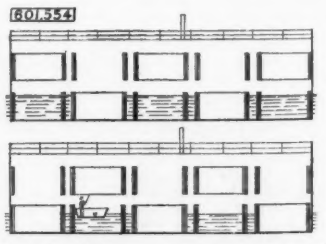


ing device connected with said ports to supply a heated fluid thereto, and an automatic shifting valve for alternately admitting said heating medium to the ends of the cylinder.

**601,554.** FLOATING DOCK, *L. E. Clark, London, England.—Filed September 9th, 1897.*

*Claim.*—(1) A floating dock comprising side walls and independent transverse caissons or pontoons forming the body of the dock and respectively detachably connected to and between the side walls, substantially as set forth. (2) A floating dock comprising side

601,554



walls, independent caissons forming the body of the dock and of greater height at their ends, means for forming detachable water-tight connections between adjacent caissons, means for detachably connecting the ends of the caissons to and between the side walls, and gates or bulkheads to form a pound, substantially as set forth.

## PETROLEUM VAPOUR: ITS PRODUCTION AND USE.

By J. S. V. BICKFORD.

WHEN undertaking some experiments about two years ago on the use and production of petroleum vapour, my firm at Camborne, of which I am the manager, found itself seriously hampered by the all but total absence of literature on the matter. There is, of course, the Patent-office, but the literature to be found there is anything but satisfactory, as it is necessary to try every plan described, many of the arrangements patented never having been tried, and though attractive enough on paper, are quite incapable of performing as described.

As others may wish for information of this class we have decided to publish, as far as possible, the results of our experience in the comparatively unknown fields of petroleum Bunsen burner, and petroleum blow-pipe work.

We have decided to refrain from following the usual practice, which is to give a long catalogue of inventions and patents, and to restrict ourselves to the description of the results of our own experience, only giving such burners as are necessary for the understanding of the principles involved.

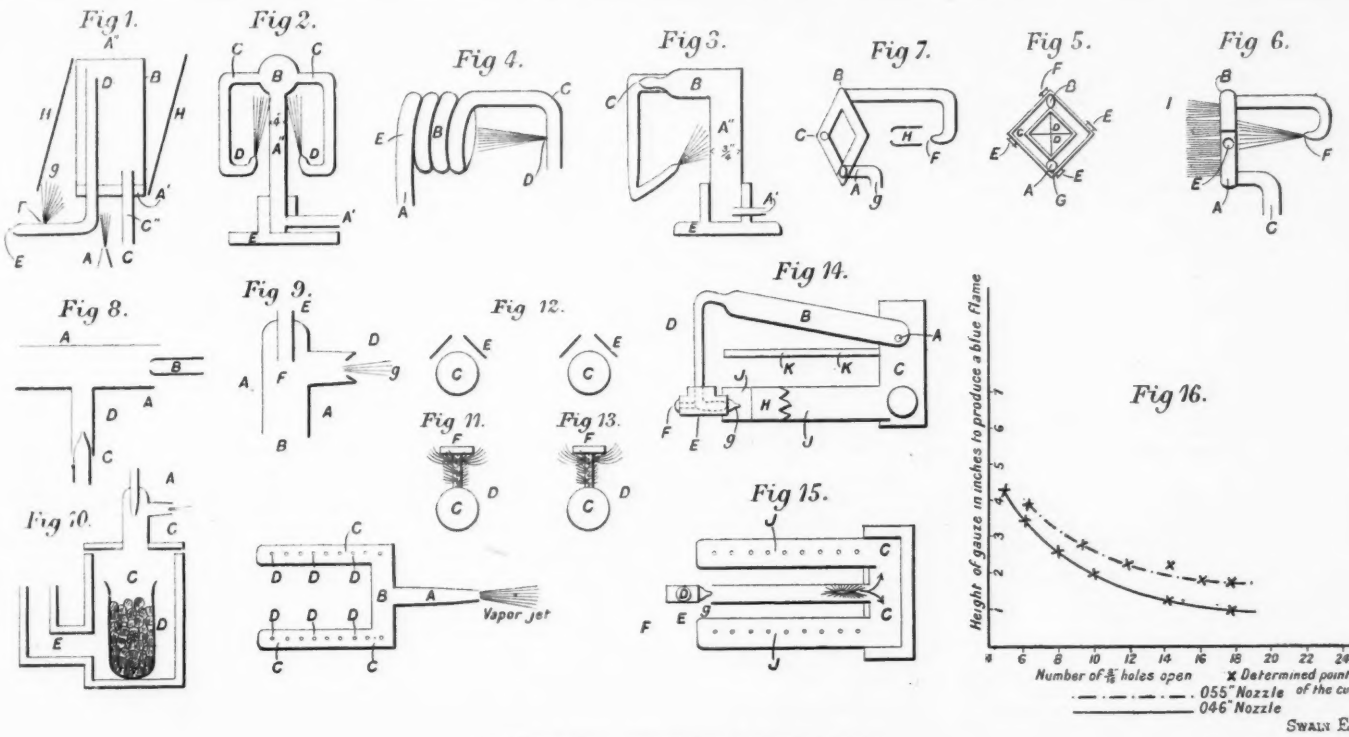
I propose to adopt the following order in treating this subject:—(1) Plain jets—(*a*) their production; (*b*) their use and combustion. (2) Blow pipes, operated with compressed air blast; with some metallurgical results obtained. (3) Petroleum Bunsen burners and their combustion.

*Plain jets; their production.*—To produce a jet of petroleum vapour it is obviously necessary that some species of retort should be used to vaporise the oil. On the form of this retort the arrangements necessary depend. To produce a steady flow of vapour it is essential that either (*a*) the cross section of the part of the retort in which the production of vapour takes place should be ness. It will be seen that the hot supply pipe C″ corresponds to a small-bore vaporiser.

To give one more example: Fig. 2 represents the principle of the "Owen" burner used with Messrs. Norris and Henty's hot-air engines. It will be seen that it consists of the stand E into which are screwed the supply pipes A′ A″. Through these the oil flows to the globe B, being vaporised on the way, and the vapour thus formed flows to the nozzle D D′ and impinges on the tube A″, where it burns. This burner requires an air vessel on the supply pipe to steady the flow of vapour. The tube A″ is about ⅛in. or ¼in. bore. Fig. 3 represents an experimental burner strongly resembling the burner mentioned above. The supply pipes A′ A″ are screwed into the stand E, the pipe A″ being about ⅛in. bore. On the top of this is screwed the elbow B, and to that the vapour-delivery pipe C, from which the vapour issues, and, striking the tube A″, burns with a perfectly steady flame without the necessity of any steadying device. It will be noticed that the only difference between the two arrangements mentioned in Figs. 2 and 3 is the size of the pipe A″, and that the one with the larger pipe burns with a steady flame without steadying devices, whilst the burner with the small tube requires an air vessel.

To sum up, it will be found that in all cases where the length of the vaporiser is more than about ten times its diameter steadying devices are necessary. Of course, special circumstances may modify this rule. In the case of the burner in Fig. 2, for instance, no doubt the ebullition of the oil in the tube A″ would throw liquid oil into the red-hot ball B, and this would, of course, cause a momentary excessive production of vapour amounting to almost an explosion; probably the same cause aggravated the trouble in the case of the burner in Fig. 1. A steadying device is necessary in a burner made up of a coil of tubing such as Fig. 4., which represents the burner used in the initial heating of our own vaporisers. vaporiser, consists of a square ring A B C, which is hollow, and in which the oil is vaporised. Oil enters at A, and is vaporised in passing through the tubes A C, C B, the vapour thus formed passing out through the tube B F to the nozzle F—Fig. 6; from this nozzle the vapour issues and strikes the vaporiser A B C, and the interrupting veins D D—Fig. 5. The result is a blue, and intensely hot, flame beyond the vaporiser, as shown at I—Fig. 6. This burner is of small capacity, and is used for heating a plumbers' furnace and the ignition tubes of oil engines. Incidentally we may mention that it is one of the most perfect bits of casting that we have ever seen, the whole apparatus being cast complete. Fig. 7 represents the Wells lighting burner. It will be seen that the only difference between this and the plumbers' lamp is in point of size, and the use of the cone H instead of the veins D. The advantage of this cone is that it lights the vapour nearer to the nozzle, and consequently produces more light. Creosote is added to the oil for the same reason. In large burners the vaporiser is also made in duplicate to insure sufficient heating surface. In all Messrs. Wells burners there is an arrangement of screws, E—Fig. 5—for cleaning out the vaporiser. The actual effect of the interruption to a jet of petroleum vapour is to retard the passage of a portion of the vapour, and by reducing its velocity to allow it to remain alight. The flame thus caused being in contact with the remainder of the vapour, ignites that, and combustion is maintained. It will have been inferred from the use of the veins in Messrs. Wells' small burner that the interruption must be of sufficient size, that is, that there is a minimum amount of interruption below which combustion is not maintained.

Possibly a few words on the various shapes of interrupter in use will be of interest. As stated above, the most common form of interruption is the vaporiser itself, but beyond this there are several recognised devices. The first of these is the truncated cone as used in the Wells light, and in many other burners, notably




SWAIN ENG

EXPERIMENTAL PETROLEUM VAPOUR BURNERS

of considerable area, and that the path of the oil should be up hill from the cooler parts to the hotter, or (*b*) that some means, such as wires in the supply pipe or an air vessel, should be used to steady the flow of the oil. In the case of the retort of large cross section with an unimpeded supply it is necessary that the supply valve should be only so far open as to just supply the necessary oil, or the burner will pulsate.

In proof of these statements the following facts can be adduced. Fig. 1 shows the burner we used for the production of petroleum vapour for most of the experiments mentioned below. B is a piece of 1½in. steam pipe plugged at both ends with iron plugs A′ A″. Through the lower of which A′ pass the supply pipe C′ C″ and the delivery pipe D E. E is the main nozzle through which the vapour issues, and F is a little hole which allows a small quantity of vapour to impinge on the gauze *g*—the use of which will be explained later—in order to keep the vaporiser B hot after starting. H H is a sheet metal mantle lined in asbestos to keep the heat in. To start this burner all that is necessary is to heat up the retort or vaporiser B and turn on oil, when a perfectly steady stream of vapour will be produced as long as the inclination of the retort is upwards. If, however, the retort is turned so that the plug A″ is below the plug A′ the burner pulsates badly. Now in using this burner for experimental work we heated it by a separate burner F), in order not to interfere with the consumption tests, and in changing nozzles sometimes the apparatus got very hot. We were for a long time unable to account for the fact that at starting, after it had been standing idle for some time, the burner pulsated badly, but settled down to work steadily in about five minutes; at last it struck us that it might be due to the pipe C″ being hot, and to prove this we took precautions that this pipe should not get hot whilst the burner was idle, and the result was the disappearance of the temporary unsteadi- This burner consists of a coil of ⅛in. gas pipe with one end turned at right angles and a hole bored through it so that the issuing stream of vapour shall pass through the centre of the coil. Its action is irregular unless some means is employed to regulate the flow of the oil. The most usual method is to fill the supply pipe with straight parallel wires for about two or three inches.

I now come to the combustion of a jet of petroleum vapour. The first fact to notice is as follows. If a jet of petroleum vapour is issuing from a nozzle at a velocity due to a pressure exceeding about one pound per square inch it will not burn unless (*a*) it is in contact with a flame, or (*b*) some solid obstruction is held in its path. Hence the gauze at *g*—Fig. 1. The second fact is that the colour of the flame depends on the distance from the nozzle at which the first ignition is effected. It does not seem to matter in which of the above ways the jet is kept alight as regards the colour of the flame. The nearer the nozzle the jet is ignited the more light it gives.

As an example, take the case of a jet of vapour issuing from a nozzle of $\frac{1}{16}$in. diameter at a pressure of 10 lb. per square inch. If the interruption is at a distance of 8in. from the nozzle the flame is blue and excessively noisy. If the interruption takes the form of a flat plate held close to the nozzle, the resultant flame is yellow and not nearly so noisy as the other arrangement. It will be noticed that the general way of keeping the vapour jet alight is to employ an interrupter of some sort, and in the great majority of cases the interrupter is the vaporiser itself. Sometimes the vaporiser is not found to offer sufficient resistance, as in the case of the Wells lighting and heating burners, and other means have to be adopted to increase the effect.

The Wells burner, which will suffice to illustrate what may be called artificial interruption, is shown in Figs. 5, 6, and 7. Fig. 5 shows the vaporiser in plan. It—the the Seigel patent lamp. The effect of this depends on the distance it is from the nozzle. It will give anything from a blue flame to a yellow. Some peculiar effects can be produced with a sheet of coarse gauze or a fine grating. If this be held normally to the path of the jet, and close up to the nozzle, the effect is a yellow flame. If, now, the distance of the gauze from the nozzle be increased, the flame becomes bluer and bluer till all colour is lost. If the distance of the gauze be then still further increased the vapour will cease to burn. In this operation as soon as the flame begins to burn blue the gauze begins to get hot, and when the distance is arranged for a blue flame the gauze becomes incandescent. In this position the flame is very noisy. The appearance is peculiar. From the nozzle to the gauze extends a column of non-burning vapour, which ignites on striking the gauze and burns beyond it with a lambent blue flame, at the same time keeping the gauze red-hot. The flame produced in this way cannot be made to smoke by any means known to us. We use a sheet of gauze fastened over the end of our starting coil at E—Fig. 4—in order to insure the vapour burning, and also to act as a heat collector to keep the vaporiser hot.

*Blowpipes.*—When we first attempted to produce a petroleum blowpipe we anticipated no difficulty whatever. It was assumed that a similar arrangement to that used in gas blowpipes would answer satisfactorily. As will probably be known, the usual method adopted in gas blowpipes for power is a pair of concentric nozzles, through the outer of which the gas issues, the air passing through the central passage. Acting on the assumption that a similar arrangement would answer for petroleum vapour, a blowpipe was constructed and tried. Before the air was turned on the vapour burned all right with a luminous, smoky flame, but the moment the air blast was turned on the flame went out.

We next tried the arrangement shown in Fig. 8. Into

a piece of ¾in. gas pipe A A was screwed the piece of ⅜in. pipe D, and into this was directed the jet of petroleum vapour C in such a way that it could not carry any appreciable quantity of air with it. This again burned until the air was turned on, when it promptly went out.

The next arrangement tried was that depicted in Fig. 9. A is a 1in. tube, having the lateral branch of about the same size C fitted with the truncated cone D, and having the air blast pipe E arranged axially with it. The air pipe E terminated about opposite the lateral branch. Into the coned mouth of D was injected a jet of petroleum vapour from the tube G. This arrangement was quite satisfactory, the resultant flame being very hot and of the true blowpipe character. One peculiarity of its action should be noticed. When in action a flame was always playing about just inside the cone D, and from there right through the body of the blowpipe to the mouth B, and if this flame was extinguished, from any cause, the blowpipe went out.

Fig. 10 shows an arrangement of a furnace, and the above blowpipe adapted for metallurgical operations, and patented by me. F is the furnace body, into the lid of which (G) is fixed a blowpipe similar to that described above. C is the pot and E the chimney. As will be seen, the arrangement of this furnace is such that the blast of the blowpipe impinged direct on the contents of the pot, effecting great economy. In the ordinary type of injector furnace the gases impinge on the outside of the pot, so that all the heat necessary for fusing the contents has to soak through the refractory sides of the crucible. The direct impact of the flames on the contents of the pot could not be tolerated were they not entirely free from sulphur and other injurious impurities. With petroleum vapour no injurious effects were noticed. Some fairly satisfactory results were obtained with this furnace. Starting all cold, 14 lb. of brass were fused in twenty minutes with 2¼ pints of petroleum. Taking petroleum at 6d. a gallon, this compares very favourably indeed with the cost of coke under similar conditions. Of course coke cannot compare with petroleum in point of time.

It may be well to mention at this point a result that was obtained at a later stage whilst experimenting on Bunsen burners. As is well known, the ordinary blowpipe is very noisy in its action, and the above-mentioned petroleum blowpipe is no exception to the rule. For this reason any arrangement which produces the same results silently is of interest. By producing the same results, we mean consuming the same quantity of oil in the same or in nearly the same space. If two pieces of ¾in. tube be joined together as in Fig. 11, and ten $\frac{3}{16}$in. holes bored in each, spaced 1in. centre to centre, and a jet of petroleum vapour from a one-sixteenth nozzle be turned into the open end A with a blast of air parallel to it, so that the vapour and air pass on and mix in the tubes before emerging from the holes; and if a bar of metal is laid close down to the holes so that the issuing streams of vapour and air impinge on it immediately on leaving the holes, the resultant flame is blue and nearly silent. We do not know what the heating effect of this arrangement would be on a crucible, but as the same quantity of vapour is consumed in the same space we see no reason to suppose that the heating effect should be less.

I now come to the Bunsen experiments. When undertaking experiments in this direction we did not anticipate any of the results produced. From past experience we were led to expect the production of a luminous but non-smoking flame. For instance, we knew that if a stream of vapour were turned into a short length of tube, and the issuing stream of vapour and air ignited, the result would be a flame of great brilliancy. Acting, therefore, on this supposition, we prepared an apparatus similar to that sketched in Fig. 11. The perforated tubes C C were about 11in. long and three-quarters of an inch bore. In each were bored ten holes of nominally one-eighth inch bore, but actually about five thirty-seconds of an inch, spaced one inch apart. Into the end of this apparatus at A we turned a stream of vapour from a nozzle one-sixteenth of an inch bore under a pressure of 10 lb. per square inch. To our surprise the streams of vapour issuing from the holes would not burn. That is, as long as a flame was in contact with them those jets actually in contact with the flame would burn, but would go out immediately the flame was removed.

On turning the apparatus upside down it was found to burn well; but with a luminous flame, so a pair of inclined plates—as shown in Fig. 12—were placed over the tubes to act as deflectors, the result being a luminous flame which was nearly silent. We then tried the effect of a sheet of coarse gauze laid across the burner tubes C C—Fig. 11—and about 2in. up from the top of these tubes. This arrangement produced a blue flame of great heat, the gauze becoming very hot indeed. It was on this principle that the first burners were produced. These burners were found to work satisfactorily till the gauze wore out; which, however, happened in a very short time, so that some substitute had to be found. The first thing tried was a cast iron grating, which showed every sign of success, but the gratings could not be prevented from cracking. Eventually, after trying a large number of experiments, we fixed on a single bar placed over the burner tube, parallel to it, as shown in Fig. 13. C C are the burner tubes, as in Fig. 11; the vapour issuing from the holes in them, D D. About 2in. from the holes are placed the flat iron bars F F, against which the streams of vapour from D D impinge, and burn with a blue flame. This apparatus has the advantage over the gauze that the flame is not so high, being flattened out by the bars, and consequently less likely to go up the chimney without doing its work, when used under a steam boiler.

The form of burner which we now make is shown in Figs. 14 and 15. The oil enters the vaporiser B by the tube A, and the vaporiser being previously heated by the starting lamp—not shown—it is immediately vaporised. The vapour thus formed passes on through the tube D to the elbow E and the nozzle G. From this nozzle the vapour issues and is injected into the air tube H—see Fig. 15—carrying air with it into the mixing or division chamber C, from which spring the burner tubes J J. From these tubes the mixed vapour and air issue by the holes bored on top of them, and striking the deflector bars K K, burn with a blue flame. Part of the heat thus produced suffices to keep the vaporiser B hot. At the back end of the elbow E is set the screw F, by removing which any obstruction can be cleared from the nozzle.

The burner just described is not silent, but may be relied on not to smoke under any conceivable circumstances, as far as we know. If it is desired to reduce the noise to a minimum, a grating is used instead of the bars K K, and is placed close down to the burner tubes J J. By this means a luminous flame is produced which will not smoke under fair conditions as to draught. In considering the noise made by a petroleum burner, it should not be forgotten what a very large amount of heat is being produced in a small space. The burner just described is about 12in. long, as regards its active area, and 6in. broad, and in this space, which amounts to about half a square foot of grate surface, it consumes up to 24 lb. of oil per hour, corresponding in efficiency to nearly double that quantity of coal. If it were desired to burn nearly 100 lb. of coal per square foot of grate area, we should hardly expect to obtain absolute silence during the operation. It therefore seems scarcely reasonable to expect a petroleum burner to work with absolute silence. That it is possible to turn out a petroleum Bunsen burner that shall work with absolute silence, or all but absolute silence, we believe, but how much oil it will burn per square foot of grate area we do not know.

The results of the following experiments will probably be of interest. The first experiments were directed towards ascertaining the amount of vapour that would pass a given size of nozzle at different pressures. Unless otherwise specified the pressure is 10 lb. per square inch. The vaporiser used was that described with reference to Fig. 1, but without the auxiliary jet, the vaporiser being kept hot by a separate burner drawing its supply from a separate tank, so as not to interfere with the results.

(1) Nozzle, ·0595in. internal diameter; consumption, 9·23 pints per hour.

(2) Nozzle, ·055in. bore; consumption, 7·82 pints per hour.

(3) Nozzle, ·0465in.; consumption, 5·66 pints per hour.

(4) ·0465 nozzle as above, at 10 lb. per square inch; consumption, 5·66 pints per hour. Same nozzle at 20 lb. per square inch; consumption, 8·67 pints per hour. As will be seen, these results work out nearly to the law that the consumption varies as the square root of the pressure. Probably errors of observation would account for the discrepancy. The consumption was taken by measuring the fall of the oil level in the tank on a gauge glass, and, as will be perceived, this would not give results of extreme accuracy.

(5) ·063in. nozzle, pressure 20 lb.; consumption, 15 pints per hour. ·063in. nozzle, pressure 10 lb.; consumption, 10·5 pints per hour.

15 squared = 225.

$$\frac{225}{2} = 112{\cdot}5.$$

$\sqrt{112{\cdot}5}$ = nearly 10·5

*Bunsen trials.*—As was mentioned above, with certain arrangements of air tubes and holes the issuing mixture of vapour and air would not burn unless interrupted in some suitable way, and when this was the case, and the interruption was placed at a suitable distance above the holes, the resultant flame was blue and non-smoking. A series of experiments was therefore undertaken to ascertain the conditions under which these results were obtained. One of the first arrangements tried was the use of a slit in the burner tubes—C, Fig. 11—instead of the holes. For some reason which we do not understand quite clearly this arrangement gives a jet of vapour and air that will burn without assistance, and which, consequently, burns with a luminous flame. It could not be induced to burn blue.

*Experiments with perforated tubes, as Fig.* 11.—The method of experiment was to have a pair of tubes bored with the maximum number of holes that it was desired to use, and to plug up a number of them with copper rivets, which were removed successively. In the next experiment the rivets were inserted successively to save time, instead of inserting the whole and then removing them progressively.

(6) Nozzle, ·0465in.; bore of holes—D, Fig. 11—⅛in. Tubes C, Fig. 11, ¾in. bore, with less than five holes open in each tube—ten in all—the issuing stream would burn without assistance, and the flame was luminous. With ten holes open a blue flame was obtained with the interruption—a sheet of iron wire gauze of about ⅜in. mesh—placed 4in. above the holes.

| | | | | | |
|---|---|---|---|---|---|
| 10 holes open. | Gauze 4in. above holes resulted in blue flame. | | | | |
| 12 | ,, | ,, | 2¾in. to 3in. | ,, | ,, |
| 14 | ,, | ,, | 2in. to 2¼in. | ,, | ,, |
| 16 | ,, | ,, | 2in. | ,, | ,, |
| 18 | ,, | ,, | 2in. | ,, | ,, |
| 20 | ,, | ,, | 2in. | ,, | ,, |

(7) Same nozzle with same burner tubes as above—⅛in.—but with eighteen $\frac{3}{16}$in. holes spaced, as before, 1in. apart.

| | | | | |
|---|---|---|---|---|
| 5 holes open. | Gauze 4½in. to 4¾in. above holes (minimum number of blue flame.) | | | |
| 6 | ,, | ,, | 4in. | ,, gave blue flame. |
| 8 | ,, | ,, | 3in. | ,, ,, |
| 10 | ,, | ,, | 2½in. | ,, ,, |
| 14 | ,, | ,, | 1¾in. | ,, ,, |
| 18 | ,, | ,, | 1½in. to 1⅝in. | ,, ,, |

For the sake of clearness I have plotted these values on a curve, which will make the matter clearer than figures—see Fig. 6.

(8) ·0595 nozzle with $\frac{3}{16}$in. holes in burner tubes spaced 1in. apart.

| | | | | | |
|---|---|---|---|---|---|
| 12 holes open. | Gauze 3¾in to 4in. | | reduced blue flame (minimum number.) | | |
| 14 | ,, | ,, | 2½in. | ,, | ,, |
| 16 | ,, | ,, | 2¼in. | ,, | ,, |
| 18 | ,, | ,, | 2¼in. | ,, | ,, |

(9) We now tried forty-two $\frac{3}{16}$in. holes spaced ¼in. apart with the same nozzle as in No. 8, but this refused to produce a blue flame under any circumstances.

(10) With 1in. burner tubes having ¼in. holes spaced 1⅛in. apart and a nozzle ·081in. bore a blue flame was produced with the gauze 2in. above the holes. This arrangement consumed about fifteen pints per hour at 10 lb. per square inch.

In all the above blue flame arrangements the noise was considerable, but nothing approaching the noise produced by a blue-flame burner without Bunsen attachment. If in any of the above Bunsen arrangements a grating be used, placed about ¼in. above the burner holes, the resultant flame is very much less noisy, but luminous. If when one of these burners is thus arranged for silent working a small jet of air is turned into the burner tube parallel to the vapour jet, the resultant flame makes no more noise than it did before, but it becomes blue.

What the rules which underlie these peculiarities are does not seem very obvious, but possibly the following may be one of them. If a jet of petroleum vapour have sufficient air mixed with it to ensure its burning with a blue flame, the silence of the flame thus produced seems to depend on the mixing being effected in a closed chamber. If the mixing is performed in a closed chamber, care being taken to prevent the flame striking back into that chamber, the resultant flame will be nearly silent, but if the mixing be performed in the open air, or partly in a closed chamber and partly in the open air, the velocity of the vapour being relied on to prevent it igniting before the requisite quantity of air has been added, the resulting flame is noisy. If this law holds good a silent blue flame would be produced in the above-narrated experiments if sufficient air could be entrained into the air tube—A, Fig. 11—to produce a blue flame without the necessity of adding more, before ignition, outside the burner tubes and between them and the gauze. It would seem from the air jet experiment that this is the case. All the above experiments worked equally well at all pressures of oil above about 1 lb. per square inch.

Several interesting peculiarities will be noticed in the above experiments. A jet of vapour in air will not burn if its pressure is above a certain fixed amount, but when we come to Bunsen work, that is when we have to deal with a mixture of air and vapour, this seems to be contradicted. For if in the arrangements mentioned above too few holes are left open, and presumably the velocity of efflux is high in consequence, then a luminous flame is produced which requires no assistance to keep it alight. If the number of holes open be increased to a certain number, or, rather, to a number lying between certain limits, the result is a stream of vapour and air that will not burn without assistance, though the velocity might be supposed to be less. Now if double the number of holes be bored in the same tubes the first result is reproduced and the jet will burn unassisted.

It would seem that this result is dependent on the fact that the addition of a quantity of air to petroleum vapour reduces the velocity at which flame can travel through it, and consequently lowers the limit of velocity with which the stream may issue from an orifice and yet keep alight unassisted. Why a slit or slits of the same area as the combined area of the burner holes should not answer we do not know, unless the friction of one part of the stream of vapour against another suffices to keep it alight; and if this is the case, why is not the same result noticed in each individual jet?

## SAMPLING AND TESTING LUBRICATING OILS AND FATS IN THE WORKSHOP.

THE analysis of oils, fats, and greases is a branch of analytical chemistry which can be successfully undertaken only by an expert analyst who has made such materials his special study. The different natures of the origin—vegetable, animal, and mineral—of fats and oils, and the complexity of their compounds, render the study of them an imperative necessity. From this last observation it may be inferred that it would be useless for the non-chemist to attempt to test an oil or fat for purity. This is so where an exhaustive analysis is required to determine the quantity of adulterant; but for ordinary purposes, which are daily occurring, there are some ready yet accurate means of ascertaining whether a lubricating oil or fat is pure or not, and, if not, what is the nature of the adulterating body. Such methods can be easily practised by the skilled operators in the workshop by paying careful attention to the following instructions.

Only such methods of sampling oils and fats are selected as can be successfully undertaken by anyone unskilled in chemistry. All that is requisite is to pay careful attention to the instructions given, being very accurate in all measurements, and faithfully following the *modus operandi* in the order given. By doing this, many foremen of a works department can successfully undertake to determine the purity or otherwise of the lubricants used in his department, and thus not only save his firm's money for analysis, but also avoid the delay incidental to submitting samples to chemists, and awaiting their report.

There are more than half a dozen methods of testing oils and fats. Those, however, which are available for our purpose, *i.e.*, such as can be performed by anyone unskilled in chemistry, are the following:—Ascertaining the specific gravity; action of alkalies in oils and fats; action of sulphuric acid on oils, &c.; testing for presence of free acid; testing viscosity; testing rate of evaporation. The testing for flash point and the chemical action of iodine and other chemicals on oils are too complicated to be performed, except by anyone expert in analytical work. The above tests are taken in the order named.

*Method of ascertaining the specific gravity of oils.*—The precise method to adopt, in ascertaining the specific gravity—sp. gr. in future—of liquids, depends on whether the fluid is heavier or lighter than water. This is so because the water

at a given temperature is taken as the standard of comparison. As oils are lighter than water, there is only need to describe one method of ascertaining the sp. gr. The principle on which the sp. gr. of a fluid lighter than water is ascertained is to make a direct comparison between the weights of equal bulks of the two fluids—water and the oil to be tested. For this purpose a bottle or flask of a special make—called a "specific gravity" or "weighing" bottle—is used. This bottle is constructed so as to hold a definite quantity of water at the normal temperatures, viz., 60 deg. Fah., 15 deg. Cent., the fluid contents of the bottle is usually 100, 500, or 1000 grains of pure water at that temperature—water, it should be remembered, varies in weight according to its temperature; an increase of temperature rendering it specifically lighter, and a decrease specifically heavier than when weighed at the above normal temperatures.

The specific gravity bottle has a closely-fitting glass stopper through which a capillary tube is made, the object of which is to permit the escape of superfluous fluid. On the side of the bottle there is scratched a mark which indicates where the given quantity of water the bottle contains reaches when weighed at the normal temperature. This bottle is filled with the specific quantity of water it is constructed to hold, and the stopper inserted and pushed down until the lower end of the stopper is coincident with the mark in the neck; the bottle is then wiped and weighed. Suppose the bottle weighs 120 grains, which, we will say, holds 100 grains when empty and dry, when filled with pure water at the normal temperature, the bottle and its contents will weigh 220 grains. If now the bottle be filled with oil instead of with water, then the weight of bottle and oil will at once indicate the relative weight of oil and water, *i.e.*, the sp. gr. of the oil. Thus, suppose the bottle and its contents—of oil—weigh 213 grains, then by subtracting the weight of the bottle—120 grains—we shall find the weight of the oil which is equal in bulk to the water which the bottle is constructed to hold, *e.g.*, (*a*) weight of dry empty bottle, 120 grains; weight of bottle full of water at standard temperature, 220 grains; then 220 − 120 = 100, weight of water; (*b*) weight of dry empty bottle, 120 grains; weight of bottle full of oil 213 grains; then 213 − 120 = 93 grains weight of oil. The sp. gr. of the oil is $\frac{93}{100}$, or 0·93. By using a bottle constructed to hold 1000 grains of water, then the sp. gr. can be carried to three places of decimals:—Weight of bottle full of water at standard temperature, 1120 grains; weight of bottle when dry and empty, 120 grains; weight of water, 1000 grains. Weight of bottle full of oil, 1052 grains; weight of bottle dry and empty, 120 grains; weight of oil, ·932. In other words, a volume of water weighing 1000 grains can be occupied by a volume of oil which weighs only ·932 grains; therefore, although the two fluids are equal in bulk, the weights are different, viz.,

$$\frac{\text{oil}}{\text{water}}\ \frac{\cdot 932}{1000} = 0\cdot 932 = \text{sp. gr. of the oil.}$$

Now, the sp. gr. of any two different oils, if pure, is never identical. If the sp. gr. of an oil, say linseed, the sp. gr. of which, when pure, is ·932, is lighter in weight than − 932 (say, for example, ·920) then we know that it is not linseed oil pure and simple, but a mixture, one of the components of the mixture being yet lighter than linseed. As the range of specific gravity of oils varies so slightly, it is very important to be accurate in ascertaining the exact sp. gr., and to ensure accuracy it is best to operate on fairly large quantities of the oil—say, 1000 grains at least. As the sp. gr. bottle is graduated to hold a definite quantity of water, it is not necessary to fill it with water, and weigh some, before testing the sp. gr. of oils. All that is necessary is to weigh the dry bottle, then fill with oil up to the mark on the neck of the bottle. Insert the stopper, allow any surplus oil to flow out through the orifice in the stopper, being careful to put the stopper down to the mark completely; then wipe dry, and afterwards weigh the contents in the manner given above, when the sp. gr. of the oil is at once obtained. After use, empty the bottle of the oil and perfectly clean it, using first a strong solution of caustic soda or potash, or else carbonate of soda and lime and a little water; but for oil which does not readily saponify with these alkalies use either strong liquid ammonia or else ether or spirits of wine, rinse thoroughly, and afterwards rinse in a little ether and dry. As the ether evaporates it will carry away all traces of moisture, then insert the stopper in the bottle and place it in its tin case to keep it dry, to prevent it imbibing moisture, the presence of which in its interior would materially affect the results obtained by weighing oil in it. If any oil be allowed to dry in the interior of the bottle it will be doubly hard to remove; a little essential oil of lavender is a remedy for softening hard, dry oils preliminary to removing them by the above means.

Besides the above, there is another method of readily ascertaining the sp. gr. of oil, which consists in the use of a hydrometer. The common form of this instrument—termed an oleometer—is seldom accurate. The instrument consists of a glass tube hermetically sealed. Inside is a paper scale graduated into divisions which represent so many degrees sp. gr. At the lower end of the tube is a bulb filled with mercury, or small shot, so as to cause the instrument to sink into the oil and steady it to keep it upright. This instrument is used by filling a tall glass jar with the oil to be tested, and then immersing the hydrometer in the fluid, the sp. gr. of which is indicated by the degree to which the instrument sinks, as shown by the paper scale enclosed; thus, the denser the fluid the less will the instrument sink. More than one instrument is used for the whole range of oils and fats, because the scale of each is divided into only a small number of degrees. An instrument with a scale of 0·730 to 0·860 is needed for the lighter oils—naphtha and burning oils—and one with a scale from 0·860 to 1000 for the various grades of lubricating oils.

It should be mentioned that the temperature of the oil should always be taken at the time of testing its sp. gr., and it should be brought to the uniform standard temperature—60 deg. Fah.—by warming it or cooling it, as the case may be, because the specific gravity of oils varies according to the temperature. To accomplish this, after filling the sp. gr. bottle, and before putting in the stopper, stand the bottle in a vessel of water, the temperature of which is 60 deg. Fah. When the oil has acquired a similar temperature, take out the bottle, wipe off all moisture, insert the stopper to the mark in the neck, wipe away any superfluous oil that overflows, and then proceed to weigh as already described.

Besides the above two methods there are others of ascertaining the sp. gr. of oils, but they are too complicated and intricate to be successfully undertaken by anyone not expert in the manipulation of chemical and physical apparatus. It should be borne in mind that the sp. gr. of an oil does not determine its absolute purity. Other tests have to be made to determine that. Thus, for example, suppose a fraudulent oil refiner were to sell an inferior lubricating oil as one of a superior class; his first object would be to blend the components so as to render the compound of exactly the same sp. gr. as the genuine superior oil. Consequently, if the operator were to rest satisfied, when he found the sp. gr. was of the right degree, that his tested sample was the genuine oil, he would be committing a grave error; therefore the sp. gr. test is only useful in telling in a quick way when an oil is pure. This may seem paradoxical, but it is explained when we say that the production of an exact sp. gr. of oils by the immixture of several components is so difficult that perhaps nine out of ten components fail to indicate the exact sp. gr. aimed at. Consequently, if the operator found a material difference of, say, 5 deg. to 10 deg., he would at once know that that oil was not the genuine one it was represented to be. For example, the sp. gr. of linseed oil at the standard temperature is 0·932; but suppose the operator found on testing a sample that the sp. gr. of the sample showed 0·925 or ·0937, he would at once correctly surmise that the oil under examination was not pure linseed. To determine what such sample was really composed of would require other and more elaborate tests than finding its sp. gr.

The sp. gr. of solid fats, such as palm oil, cocoa-nut oil, butter, &c., is not so easily ascertained as that of fluid oils. One of the simplest methods is to take a wide test tube that can be tightly covered with a cover, such as a boxwood cork stopper. First, weigh the tube and its stopper while perfectly clean and dry, then fill it with water, wipe off all moisture from the outside and weigh it again, then empty it of water and perfectly dry it, and having melted at a low temperature some of the solid fat to be tested, fill the tube with that, and allow it to cool down, and again weigh the tube with the solid fat in it. The sp. gr. of the solid fat is then easily ascertained by the calculations already referred to. Thus subtract the weight of the tube and cork from the weight of the tube, cork, and water; also subtract the weight of tube and cork from weight of tube, cork, and fat, and then divide the weight of the fat by the weight of the water, when the sp. gr. is at once obtained, *e.g.*:—Suppose the weight of the tube, cork, and water be 250 gr.; weight of tube and cork be 50 gr.; ∴ weight of water equal 200 gr. Weight of tube, cork, and fat, 245 gr.; weight of tube and cork, 50 gr.; weight of fat, 195 gr.

Therefore sp. gr. $\frac{195}{220} = 97\frac{1}{2} = 0\cdot 975$.

The following specific quantities are those of the oils most commonly used in making lubricating compounds, the sp. gr., as given below, being taken to be when the oil is at the standard temperature, viz., 60 deg. Fah.:—

| | |
|---|---|
| 0·875 mineral oil. | 0·919 almond oil. |
| 0·883 sperm oil. | 0·923 cotton-seed oil. |
| 0·903-7 mineral oil. | 0·923 sesame oil. |
| 0·912 lard oil. | 0·925 whale oil. |
| 0·912 tallow oil. | 0·925 cocoa-nut oil. |
| 0·914 rape oil. | 0·925 mineral oil. |
| 0·914 neatsfoot oil. | 0·932 linseed oil. |
| 0·915 olive oil. | 0·940 palm oil. |
| 0·920 arachis (ground or earth nut) oil. | 0·940 tallow. |
| | 0·964 castor oil. |

(*To be continued.*)

## THE LARGEST STORAGE BATTERY IN THE WORLD.

SOME time ago our American correspondent described a great storage battery plant for electric lighting service, which is by far the largest battery in the world, and we are now enabled to give further particulars of the installation in the basement of a sub-station of the Chicago Edison Electric Company. The battery was built and erected by the Electric Storage Battery Company, which is a corporation owning nearly all the practically important American patents on storage batteries.

The growth of the electric company's business last year was such that the maximum winter demand in the district comprising the business centre of the city increased from 36,000 ampères in 1896 to 44,000 ampères in 1897; and should the present growth continue, the winter maximum of 1898 for this district will be not much less than 55,000 ampères. It became evident, therefore, that a point had been reached where new investment in machinery or battery had to be made. The peak of the load occurs in winter time at about 4.45 p.m., and is about 12,000 ampères in height, with an average width varying from three-quarters to 1¼ hours.

The conditions for a battery installation, from a point of investment, were very favourable, since the current is carried from the Harrison-street generating station to a sub-station in the company's office building in Adams-street, over a trunk line 3500ft. in length, and then distributed. The Adams-street sub-station was therefore a very favourable point for a battery installation, since a large trunk line investment was avoided. Moreover, the centre of load of the system has been gradually moving farther away from this sub station or distributing station, so that for good regulation at time of maximum load in winter, with feeders varying from 800ft. to 3000ft. in length, either a booster system or a large outlay in copper had to be considered. The battery filled the requirements of the situation, being designed to discharge on two voltages—125 volts to accommodate short feeders, and 140 volts for certain long feeders. It is also equipped with a third and cell switch, so that still another voltage of discharge can be obtained should the future necessitate it.

The battery is placed in the basement of the company's office building, in Adams-street. Precautions were taken to see if the footings of the columns supporting the floors above would be sufficient to sustain the weight of a duplicate installation in the future. New footings were necessary, and the building temporarily shored up. The question of permanency in every detail was the first consideration, as the size of the installation and the limited area and headroom made alterations in the future out of the question.

The matters of sub-drainage, surface drainage, supports for the cells against ceiling, the floor construction, the protection of the columns and iron beams supporting the upper floors of the building, and the ventilation of the battery-room were most carefully considered. A sub-drainage system of 3in. tile pipes laid in concrete was installed. For surface drainage lead pipes were laid in sand, draining several lead-lined sumps, and both draining into a large sump at the extreme south end of the room, which is emptied by a lead-lined centrifugal pump, and discharged to the sewer. To prevent settling, five 4in. rolled steel joists were laid crosswise under the cells, the space between being filled with concrete. Over this bed a few courses of tarred felt were laid.

The floor is of vitrified shale tiles, 10in. by 11in. by 2in., laid in a mixture of 70 per cent. of asphalt to 30 per cent. of coal tar. The bottoms of the steel columns of the building are encased in lead. The columns were thoroughly cleaned, then treated with a galvanic varnish, and afterwards encased in wire lathing and covered with an alkaline cement plaster, which was then covered with a coating of anti-acid paint. All the walls and ceilings are treated with the same plaster, and are thus rendered impervious to acid fumes.

For ventilation two sheet iron pipes on opposite sides were run the entire length of the room, one for blowing in fresh air, the other for exhausting. This affords several cross currents of air, and effectually removes the gases, which are conveyed to the outer air by pipes extending above the level of the roof.

The battery has a capacity of 22,400 ampère hours at an eight-hour rate, and will be able to discharge 11,000 ampères for about 1½ hour. It consists of 166 cells—60 of which are end cells—there being 83 cells on each side of the three-wire system. This large number of end cells is required to meet the wide conditions of pressure. The battery is called upon to deliver 140 volts on each side at the end of discharge, and in case of an emergency to deliver current at the maximum of 120 volts on each side when fully charged. Each cell contains 87 plates, whose dimensions are 15½in. by 32in. The positives are of the standard Manchester type. Each cell or tank is 21½in. wide by 79⅝in., and 43⅞in. high, and weighs 6200 lb. The total weight of the battery—exclusive of conductors—is 460 tons. The tanks are constructed of 2in. ash boards, lined with sheet lead. They are each supported on ten double petticoat insulators, resting on tiles laid on the acid-proof floor.

The end cells are connected to the end cell switches by lead-covered copper bars, 6in. by ¼in., supported by insulators resting on rolled-steel joists fitted between the columns of the building. The main connection of the battery consists of two copper conductors, giving a sectional area of six square inches. The lead coating of the copper is a special feature which renders the copper impervious to the action of the acid and gases.

There are three end cell switches on each side of the system. These switches have 30 contacts, and are capable of carrying 2750 ampères each. The connection between the 30 contacts and the bus bar of the switch is made by a laminated copper brush travelling on a screw operated by a ½-horse power series motor. These motors are put into operation by push buttons on the controlling switchboard, but are stopped automatically when the brushes reach the mid point on the contact blocks by an automatic device which breaks the motor circuit and short circuits the armature. This method ensures the positive action of the end cell switch without requiring attention of the switchboard operator. These switches are provided with a hand wheel for hand operation if desired. Gear wheels are also provided, so that the three switches can be geared together and operated as one switch, thus giving a capacity of 8250 ampères on each side of the system.

The controlling board is connected to the bus bars of the end cell switches by twelve cables of 1,500,000 circular mils each. On the controlling board there are three single-pole switches for each end cell switch, enabling it to be connected to either the main, auxiliary, or charging busbars. Each end cell switch has an indicator on the controlling panel, operated mechanically by light shafting and gearing, which shows the operator the exact position of the travelling brush on the end cell switch at all times. On each panel of the board there is a thirty-point volt meter switch connected to a low reading volt meter, which enables the operator to take the voltage of the end cell switches.

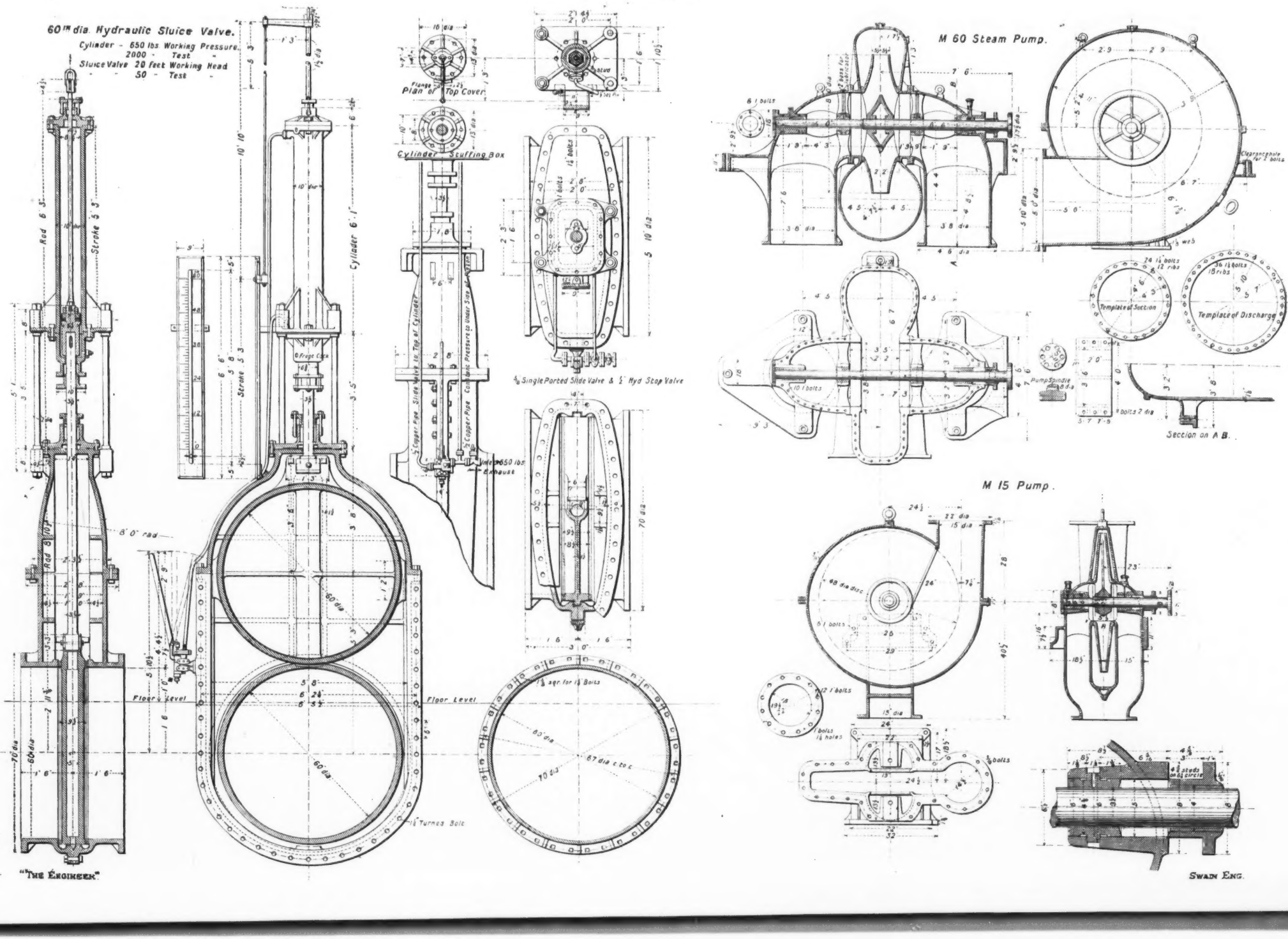
One of the important features in connection with the battery installation is the method of charging without the use of boosters, which are ordinarily employed in American battery installations. The method of charging this battery is to operate a pair of 200-kilowatt generators in the Harrison-street central station at about 180 volts, which is the voltage required for charging, and to send the current over a portion of the trunk line from this station to the battery station in Adams-street. The voltage regulation of the dynamos is effected by an automatic control of the field resistance by means of small motors, which are controlled by the operator in the distributing-room of the battery station, small lead-covered cables from Adams-street to Harrison-street connecting with the motors controlling the field boxes. The charging will be done after midnight, when the load on the generating plant is at its lightest. The generators which are used for charging are not generators specially made for the purpose, but are the same which at other periods of the day are used to feed into the main bus bar of the station, thus saving an investment of about £3000 in boosters, as well as providing a system of charging, which is very much more economical than the one in which boosters are employed.

The battery will be kept in circuit at all times during the daytime; in summer floating on the circuit, keeping the engines at the central station working at the most economical point. The battery will be ready at any time to take care of any sudden increase in load which may occur in the system, as well as to take care of the peak in winter time, for which purpose it was primarily provided. By maintaining the battery on the circuit continuously the necessity for regulation of pressure at the central station is very much lessened.

STOKEHOLDS IN THE TROPICS.—A New York Press correspondent, writing from Key West, June 13th, says:—"An engine room and a stokehold on our war vessel are not, even in high latitude, places where one would seek to cool a fevered brow, but in the tropics they become counterparts of pits infernal. Some of the more pessimistic officers of the Navy are afraid that if the war is drawn out long the firemen of the fleet will be unable to stand the strain, and that when the break comes they will go by the dozens. So far they have stood it well. But they have suffered much, and the heroism of clearing a fire in the bowels of a blistering warship on the Carribean Sea is of the hourly and every-day kind that recieves neither reward nor glory. Frequently when the New York Press despatch boat, on which I have been, was cruising on the south side of Cuba, the thermometer in the cook's galley, a small deckhouse with doors open on either side, registered 135 deg., and would have registered more if the thermometer had been graduated higher. What must have been the heat in the fire room? Almost naked skeletons of men, hoisted up to the deck to lie gasping until revived by outward applications of water and inward applications of stimulants, told us of the terrors of those superheated depths.'

# PUMPING MACHINERY, GLASGOW GRAVING DOCK

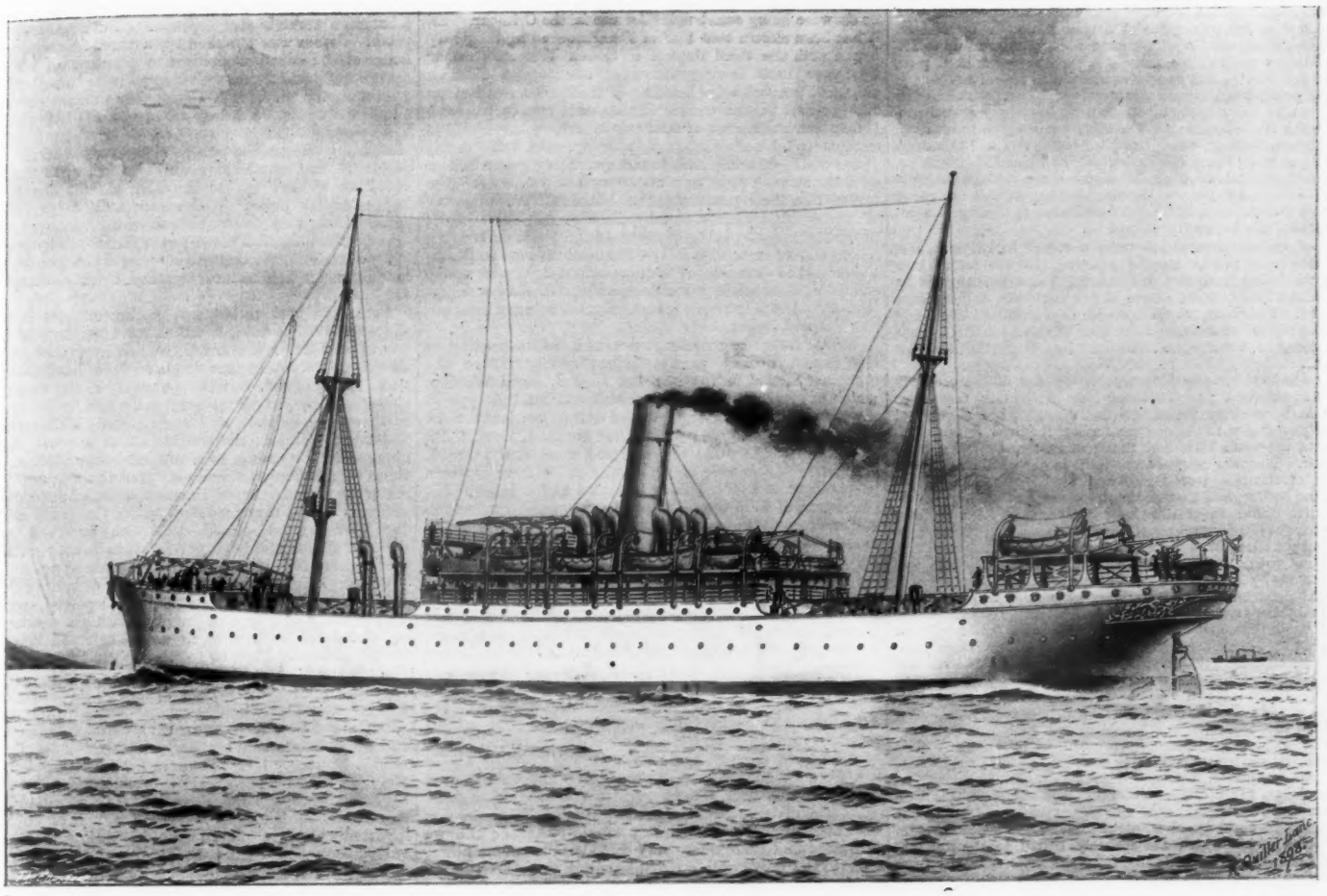
(For description see page 53)




"THE ENGINEER"

# JAPANESE MAIL STEAMER SADO MARU

MESSRS. WORKMAN, CLARK, AND CO., LIMITED, BELFAST, BUILDERS



## THE MAIL STEAMER SADO MARU.

We illustrate above a very fine steamship, built by Messrs. Workman, Clark, and Co., of Belfast, for the Nippon Yusen Kaisha (Japan Mail Steamer Company, Limited), Tokyo. The ship is 445ft. long by 49ft. 5in. beam by 33ft. 6in. deep, moulded; draught, 25ft. 8in., load; displacement, 12,320 tons; dead weight, 7640 tons. She is propelled by twin screws. The triple-expansion engines have cylinders 20in. and 33¾in. and 56in. diameter, with 48in. stroke; the crank shafts are 12½in. in diameter; steam is supplied by two single-ended boilers, 13ft. 6in. diameter by 10ft. long, and two double-ended boilers, 13ft. 6in. diameter by 17ft. long; 6100 square feet heating surface; 200 lb. per square inch working pressure. She is the second ship of this kind built by them for this line, the first being the Kamakura Maru, about two years ago. She is fitted up throughout in the best style for a large number of first and second, besides a considerable number of third-class passengers. All the latest devices for rapidly discharging and loading cargo have been adopted in her, and she is fitted also with electric light, electric bells, and a complete installation of refrigerating plant.

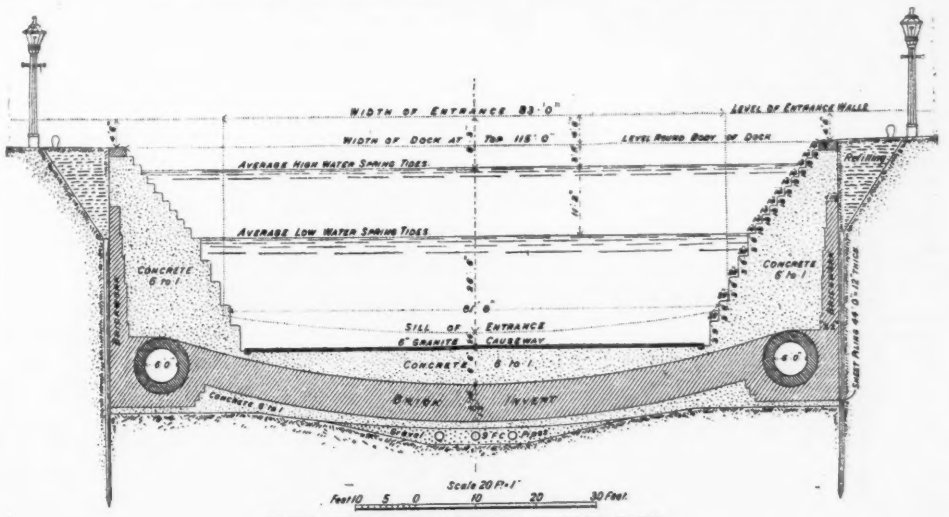
## THE NEW GRAVING DOCK FOR THE CLYDE.

No. III.

WITH the sectional views of the pumping engines for the new graving dock at Glasgow, given in our last week's impression, we described generally the culvert and pumping arrangements, but made only very brief allusion to the engines and the pumps themselves. We now give a sectional elevation of the Gwynne pumps, and of the hydraulic sluice valves alluded to in our last week's impression, and a description of the pumping installation as a whole, including engines, pumps, boilers, feeding and forced draught arrangements, &c., and in a final article complete the information as to the construction and equipment of the dock.

The Clyde Trust invited tenders for engines and centrifugal pumps of the highest class, which should, within a period of two hours, empty the dock from a point 26½ft. above the sill, giving about 28¼ft. of water from the floor, thus discharging in that time the large quantity of 13¾ million gallons of water—approximately 61,000 tons—against the head of water in the river, the tide outside the dock meanwhile falling in the usual course 4½ft. Some seven or eight firms tendered for the work, and after due deliberation it was entrusted to Messrs. Andrew Barclay, Sons, and Co., Limited, Caledonia Works, Kilmarnock, who undertook the whole of the work, and included in their offer centrifugal pumps by Messrs. Gwynne and Co., of Holborn, London. The Trust specified that the engines should be non-compound and drive the centrifugal pumps direct.

The engines which Messrs. Barclay, Sons, and Co., offered, and which were accepted, and are now installed, consist—as was seen in our illustrations in last week's impression and that of June 17th—of two pairs of inverted direct-acting expansive marine type engines, open fronts, each pair having the crank shaft coupled direct to the spindle of the Gwynne pumps. The engine cylinders are 28in. diameter by 24in. stroke, and work up to 120 revolutions per minute, with steam at a boiler pressure of 110 lb. per square inch. The piston-rods are 4⅞in. diameter; the connecting-rods 4⅞in. to 5¾in. diameter; crosshead pins, 6½in. diameter by 9in. long in the bearing. The crank pins of the double-web right angle cranks are 9½in. diameter by 10½in. long, the cranks being carefully balanced by balance weights secured by fitted bolts. The shaft journals are 8¾in. diameter, with massive gun-metal square seated steps, each shaft running on an aggregate length of bearing of 46in. The cylinders and covers are steam jacketed, separate liners being fitted to each cylinder. The pistons are fitted with Lockwood and Carlisle rings. The slide valves are of the double-ported type, giving a minimum of travel, and are provided with expansion valves, having expansion gear on the Meyer principle, operated by means of suitable gear from the floor of the engine-house, the expansion valve spindles being gun-metal lined. The main valves are each balanced by pistons working in cylinders on the steam chest covers, the pistons being connected by vibrating links, one to each side of each main valve. The sole-plate and back columns of engines are massive and of cast iron, and the front columns are of polished wrought iron. The principal working parts are of steel, except the smaller pins and links, which, with the eyes in which they fit, are of wrought iron, carefully case-hardened, lapped, and finished. The engines are fitted with the usual accessory parts, such as convenient drainage and indicating cocks, gear, &c.




CROSS SECTION OF GLASGOW GRAVING DOCK

The Gwynne pumps, which we are enabled to show in section on page 52, are amongst the most powerful ever constructed for dock work. The pump shafts are 8in. diameter, and, like the engine shafts, have solid forged couplings 3in. thick with six 2½in. turned and fitted bolts for connecting up. The pumps have each two 44in. suction inlets, the pipes from which are carried down 5½ft. below the top of sump and bell-mouthed, these inlet pipes having been suspended from the pumps before the latter were rigidly connected up to the engine and discharge pipes. At the completion of the connection the space round about the inlet pipes was filled by cement concrete. The discharge pipes from the sump to the river are 5ft. diameter from each pump, and are each fitted with a 5ft. Glenfield sluice valve, having a hydraulic cylinder and connections for opening and closing, and indicating the opening at any point, all as shown our illustration. There is also fitted to the end of each 5ft. pipe, and lying at an angle, a foals-foot flap valve, which is of double thickness elm, 6in. in all, and hinged at the top of the pipe on spindles with phosphor bronze linings. These valves are practically balanced by counterweights hanging from chains which pass over pulleys, and are attached to the points of the valves. These flap valves are precautionary in their character, since they are automatic, and would close in the event of any rush of water from the river to the engine-house or dock. Ejectors are fitted to each pump to eject the air, and to prime the pump if the water is low at any time when starting the engines, the ejector pipes discharging into the river at approximately the cope level.

Besides the pumping machinery and accessories, the work devolving on Messrs. Barclay, Sons, and Co., included the necessary foundations throughout, and the whole has been very substantially executed, as indicated by the sectional view above. Manholes in culverts giving access to the foundation bolts of both engines and pumps have been left in the floor of the house, and the pumps can be readily lifted entirely away from the suction pipes in case of need. The 5ft. discharge pipes were, with the exception of one or two bends, made at Messrs. Barclay, Sons, and Co.'s foundry, along with the whole of the castings for the engines, and the pipes were embedded in the brick and concrete walling of the dock some months before the engines and pumps were delivered, a spigot and socket joint being left at the engine

house and to allow for proper adjustment of the pumps on their seats when being erected.

An auxiliary 15in. centrifugal pump, with 14in. direct-driving engine, is fitted at a level of 5ft. 9in. below the engine-house floor, and its suction pipe extends below the bottom of the sump, so that this and the dock may be drained entirely dry, the nose of the suction pipe being covered by a rose and a full-way valve of a special design by Messrs. Barclay, Sons, and Co. This engine and pump run up to 275 revolutions per minute, and discharge through a 15in. pipe, with sluice valve and flap valve into the same culvert as the larger pumps, and communicate with the river, which at low tide covers the mouths of all the discharge pipes, and prevents the admission of air. The other auxiliary plant installed by Messrs. Barclay, Sons, and Co., comprises a 7-ton overhead travelling crane of Marshall, Fleming, and Jack's make, seen in our illustration of the engine-house interior, in issue of 17th June, two pairs of Cameron donkey pumps, 6in. rams, by 6in. stroke, and a Berryman feed-heater by Messrs. Wright, of Tipton, all afterwards referred to.

The engines throughout were specified to be, and are, finished equal to best marine practice, and the installation as a whole has been started, and kept going since the opening without a hitch, to the credit of the engineers and all concerned. The plant, we understand, does excellent work, and on the official trial emptied the dock in one hour thirty-eight minutes, or twenty-two minutes less than the contract time.

The boilers for pumping machinery are of the ordinary tubular marine type. These are four in number, any three of which, working under assisted draught, are capable of supplying steam to the engines for the required duty. The boilers are each 12ft. 6in. mean diameter, by 10ft. mean length. They are designed and built in accordance with the rules of the Board of Trade and of Lloyd's Register for marine boilers, and to the requirements and survey of the Scottish Boiler Insurance Company, Limited, for a working pressure of 130 lb. per square inch. The working pressure in actual practice, however, is not more than 110 lb. per square inch, as provided for in the general specification which was drawn up by Mr. Baxter, mechanical engineer to the Trust. Each boiler has two flues of the Morrison patent corrugated type, made by the Leeds Forge Company, Leeds. They are of the removable type, and can be taken out of the boiler without cutting or disturbing any of the plates, either at the combustion chamber or at the front end of the boiler. The diameter of each flue is 3ft. 9in. inside the corrugations, and the thickness is $\frac{13}{32}$in. There are in each boiler 326 tubes 2$\frac{3}{4}$in. outside diameter, and 7ft. long between the tube plates. These tubes are of iron, lap-welded, and each was tested by hydraulic pressure, internally applied, to 1100 lb. per square inch. The total heating surface in each boiler is 1711 square feet, and the grate area 40$\frac{1}{2}$ square feet. All the plates, water-space stays, and rivets, are of mild Siemens steel, tested to the usual requirements of the Board of Trade, while the steam-space stays are of wrought iron. Each boiler is set on cast iron stools which are securely bolted to the concrete foundations. The waste gases from the boilers are led from the smoke-boxes by means of downtakes into an underground flue, and thence to the chimney, which is square in section, measuring 5ft. 9in. inside at the top, and 100ft. in height above the cope level of the dock, or 97ft. 6in. above the level of the fire-bars in the boilers.

In designing the boilers consideration had to be given to the fact that the demand for steam increases as the level of the water in the dock is lowered, reaches the maximum when the dock is almost emptied, and then suddenly ceases. To meet these conditions, and to have the means of regulating the supply of steam without having to provide boilers of much larger dimensions, it was decided to apply a system of induced draught. The system employed is Patterson's, and was fitted up by the licencees, Messrs. M. Paul and Co., Dumbarton. The installation of the system in this case is designed to increase the output of the boilers, in comparison with natural draught performances, about 100 per cent.; and the convenience of it in such a case, where the boilers are required to run up from nothing to a high duty for a couple of hours and then shut down, is considerable. By its adoption, also, the first cost of the boilers and fittings necessary to do the duty has been considerably reduced.

For this installation there are two fans each 7ft. 9in. diameter, and each driven by a single independent engine, with a steam cylinder 7in. diameter by 5in. stroke, the ordinary number of revolutions being 300 per minute. In the event of either of the fans or engines breaking down or being under repair, the other fan running at 400 revolutions per minute will manage the duty required. The fans are placed one on each side of a central trunk, which is set above the main flue between the boilers and the chimney, and which can be shut off from the flue by means of a swinging damper. The gases on being drawn into the fans are met by a finely-divided water spray, and, thus cooled and cleansed, are discharged into a casing, from which they escape to the chimney. A drain in the bottom of the casing provides for the escape of the water, which takes with it the bulk of the solid particles carried over by the waste gases. The water supply for this spraying process is obtained from a pipe connected to the auxiliary pumping engine before alluded to, placed on the floor of the engine-room, and having a suction pipe led to the drainage pit in the engine-room, and a discharge to the main culvert, as already explained.

The boilers are fed by two of Cameron's patent two-cylinder double-ram pumps, 6in. rams by 6in. stroke, which draw from a tank overhead, filled by a pipe led from the Govan water mains, either pump being capable of feeding the boilers. The pump discharge arrangements are such that the feed-water may be passed either direct to the boilers or through a large feed-water heater of the Berryman type, the heat for which is derived from the exhaust steam of the main engines, which passes through the heater. By an arrangement of stop valves in the pipes, the exhaust steam from the engines is wholly or in part made to pass through the heater, or led direct up the chimney to the atmosphere. The feed-heater is capable of heating 3000 gallons of water per hour to a temperature of 200 deg. Fah. The feed-pipes are entirely of copper—20 per cent. heavier than the requirements of the Board of Trade. The steam pipes, 14in. diameter, leading from the boilers to the main range in the engine-house are all of cast iron, except the bends, which have been made of copper, to the extra requirements above stated for the feed-pipes. The contractors for the boilers and piping were Messrs. Lindsay, Burnet, and Co., More Park Works, Govan, Glasgow. The steam pipes, as well as the engine cylinders, were covered by the Scottish Asbestos Company's composition, the latter being neatly overlaid with blue planished steel.

## SHIPBUILDING AND MARINE ENGINEERING ON THE THAMES IN THE VICTORIAN ERA.

No. XX.

ALTHOUGH the "Ironclad Age" may be said to have had its advent at the time that armoured wooden gunboats were being constructed for use in the Crimean War, it has been shown that that of the armoured fighting ship began with the third decade of Queen Victoria's reign; the year 1859 having witnessed our largest Thames shipyard busy with the building of the first sea-going iron armour-clad in the world. This vessel was, as we have shown, the forerunner of similarly armoured ships built at various royal and private shipyards, until the closing year—1867—of the decade found our Navy possessed of over thirty such fighting craft, several of which were iron hulled like their prototype, the Warrior. The majority of these ships were fitted by Thames engineers, their propelling engines being of several types, and embodying—in the later ones especially—the most modern improvements in the direction of economy in weight and space occupied, increase in propelling power, reduced consumption of fuel, and in the details of construction and arrangement on shipboard.

In this latter connection, we would, before passing to the fourth decade of the reign, briefly notice the machinery fitted to the ironclad H.M.S. Lord Warden, which was a still further improvement on the type of engines illustrated in Figs. 99 and 100 in our last article.

This ship, designed by Mr., now Sir E. J. Reed, C.B., was built in Chatham Dockyard, and completed in 1866. Her hull, which was of wood, was 280ft. long between perpendiculars; 59ft. broad, and she had a loaded displacement of 7675 tons. She was armoured from end to end with iron plates varying from 4$\frac{1}{2}$in. to 6in. in thickness, carried on a teak backing 31$\frac{1}{2}$in. thick. Her propelling machinery, supplied and fitted by Messrs. Maudslay, Sons, and Field, consisted of a pair of three-cylinder horizontal return connecting-rod engines of 1000 nominal horse-power. As they were very fully illustrated in this journal during the year 1866, we would refer all who are interested in the arrangements of the propelling machinery of our early war and other steamships to the issues of that date. To those of our readers, however, to whom those issues are not available, a brief description of the Lord Warden's engines may be worth giving.

At the time of their design and construction, although higher steam pressures than those previously in use at sea were becoming more frequent, yet the opinion was then generally held among engineers that except under very special circumstances, the expansion of steam was best begun and completed in a single cylinder; and we therefore find that where any considerable engine power had to be developed on shipboard it was preferred to obtain it from three equal-sized cylinders, working with the same initial steam pressure and driving separate cranks, rather than with a less number of larger size, with a consequently greater and possibly unequal strain on their working parts. It was doubtless with such considerations that the type of engines fitted in the Lord Warden was planned, as several sets of smaller power of the same design had previously been built and fitted by the same makers.

Those made for the Lord Warden were, as we have stated, of 1000 nominal horse-power, and were also the largest three-cylinder engines built by the firm up to that time—1866. The cylinders, which were laid side by side, though not connected together, were each 91in. diameter, with a piston stroke of 4ft. 6in., and steam jacketed throughout, the cranks being set at 120 deg. apart. The way in which the distribution of the steam to the cylinders of these engines was effected was a principal feature in their design; the ordinary double excentrics and link motion being replaced by what came to be known as the "Sell's valve gear," the invention of a member of the maker's firm.

In this gear the main slide valves of the engines—there were no separate expansion valves—were worked by a crank shaft running across the engines in front of the valve chests, and driven by a train of four spur wheels from the main crank shaft of the engine. The two intermediate wheels of the train were mounted in a movable frame which could be raised or lowered at pleasure, the effect of which was to vary the position of the cranks that worked the slide valves so as to make them cut off the steam sooner or later, or to reverse the engines, the idle wheels gaining or losing half a revolution by the shifting of the frame in a way which is sufficiently obvious to render detailed description unnecessary.

The engines were fitted with two surface condensers, one at either end of them, and directly opposite the two outside cylinders. They had brass tubes through which the steam passed, the cooling water surrounding them, and were kept tight in the tube plates with screwed stuffing-boxes and tape packings. The cooling water was driven through the condensers by horizontal circulating pumps worked direct from the engine pistons, the air pumps being actuated by arms attached to the outside piston-rods of the forward and after cylinders. Steam was supplied by tubular boilers, having a grate surface of 700 square feet, and a total heating surface of 19,000 square feet. They were fitted with Mr. Field's superheating apparatus, consisting of rows of flattened 3in. tubes in the uptakes. On her first steam trials the engines of the Lord Warden developed 6706 indicated horse-power, the mean pressure in the cylinders being but 20 lb. to the square inch, a greater result than ever before attained. The total cost of this fine vessel is recorded to have been £345,082.

Within the decade 1857—1867 Messrs. Maudslay, Sons, and Field had established a shipyard and boiler-making works at East Greenwich, and the Thames Ironworks Company at Blackwall had increased its borders by the addition of eight acres of land to the works and the construction of two graving docks, the larger of which would accommodate vessels of great capacity. In the closing year of the decade—1867—the same company built and completed in its new engine shops its first pair of marine engines. These were constructed for the screw steamship Earl de Grey and Ripon, which was a vessel of 150ft. length on deck, 21ft. 6in. beam, and 12ft. depth of hold. They were of the double-cylinder return connecting-rod type, and drove a common three-bladed screw of 9ft. diameter and 14ft. pitch. Steam was supplied by a three-furnaced tubular boiler of box form, worked at a pressure of 22 lb. per square inch, and fitted with a tubular superheater in the uptake to dry the steam thoroughly and to prevent its condensation while being expanded in the cylinders. Each engine had its own surface condenser, air and circulating pumps, the pumps being worked off the engine pistons. The condensers were so arranged that they could be worked by jet injection should any accident happen to the pipes. With steam at 19 lb. pressure per square inch, and the engines making 82 revolutions a minute, the indicated horse-power developed by them was 332·6, the coal consumption being 2$\frac{1}{2}$ lb. per horse per hour, a result then seldom equalled in more complicated engines.

From the various types of marine engines in use in the years 1857 to 1867, it will have been noticed in our record that the predominant one has been that in which the steam cylinders were disposed in a horizontal position. This, of course, was a necessity in the case of warships, as their propelling machinery had to be kept out of the reach of shot, and consequently below the load water-line. But as the screw had, in a great measure, superseded the paddle as a propeller in merchant ships, there was no longer a necessity that the warship type of screw engines first used in screw steamships should be adhered to; we therefore find, before the third decade of the Victorian era closed, that the inverted vertical cylinder engine had been getting into favour with shipowners, and that its use was largely extending.

Of our Thames marine engineers, we believe Messrs. Humphrys, Tennant, and Co., of Deptford, were the first to adopt this type of engine—with jet condensers—for commercial purposes, as was illustrated in our sixteenth article by Figs. 89 to 91. With the exception of Mr. Spencer's surface-condensing inverted cylinder engines—illustrated by Figs. 97 and 98 in our eighteenth article—no other Thames engineering firm, we believe, adopted this type of engine until Messrs. Maudslay, Sons, and Field constructed those which they fitted in the Lady Derby, belonging to the General Steam Navigation Company, in 1865. These engines—which we illustrate in Fig. 103, on page 55—were of 600 indicated horse-power, and consisted, as shown, of a pair of equal-sized inverted cylinders placed side by side, with the slide valves between them; the main slides, which were double-ported, being actuated by double excentrics and slotted links, and the expansion valves—working on the back of the main ones—driven by single excentrics.

The cylinders were steam-jacketed throughout, and exhausted directly into a vertical tubular surface condenser, placed close behind centrally between the cylinders as shown. The air and bilge pumps, which were forward of the condenser, were worked by an ordinary pump lever, motion being imparted by a link attached to it, and a pin in a crank disc keyed on to the forward end of the main crank shaft—which was a solid forging without couplings—the feed pump being actuated by the same motion as shown. The reversing of these engines was effected by the ordinary worm and sector gear worked by hand. Several pairs of this type of engine were constructed by the Messrs. Maudslays before the close of the year 1867 for commercial vessels, and gave great satisfaction in their working.

### THE FOURTH DECADE OF THE ERA, 1867 TO 1877.

In the earlier part of the first year—1868—of this decade nothing particularly worth noting in direct connection with either shipbuilding or marine engineering on the Thames took place, but towards its close there was every appearance that history was about to repeat itself in the attempted launch into that river, not of a monster ship like the Great Eastern, but still of a great iron floating structure that weighed not less than 8350 tons.

The British Government having been for some considerable time previously impressed with the necessity of providing dock accommodation for the ironclad and other ships which constituted our North American and West Indian squadrons, determined early in 1866 to provide a dock capable of receiving such vessels at Bermuda, a half-way place of call between England and her Colonies on the North American and West Indian station.

The idea of constructing such a dock of stone after long consideration having had to be abandoned, on account of the porous nature of the rock forming the island, it was eventually decided to build a floating dock of iron, capable of docking any vessel then afloat, with the exception of the Great Eastern, and the type of structure determined upon was in accordance with the patented design of Messrs. Campbell, Johnstone, and Co., of the Albert Works, Silvertown, North Woolwich.

This dock was shaped somewhat similar to the middle part of a long ship, without bows or a stern. Its dimensions were:—Length overall, 381ft.; between end caissons, 330ft.; breadth overall, 124ft.; between sides, 84ft.; depth overall, 74ft. 5in.; and depth inside, 53ft. 5in.; the thickness of the plating in its walls or sides varying from $\frac{3}{8}$in. in the bottom to $\frac{5}{16}$in. at the top. From these dimensions it will be seen that the deck was double-bottomed, and had double sides, an inner and an outer one, which were 20ft. apart. It was divided longitudinally into eight water-tight compartments on either side of the middle line keelson, each of which was subdivided transversely into three parts, and known as the "load," "air," and "balance" chambers, smaller compartments being provided for the pumps, moving machinery, capstans, cranes, &c.; all of which were worked by steam, and were constructed at the Albert Works, North Woolwich.

The time taken for docking a vessel in the Bermuda—the dock's name—was not greater than for a similar vessel in an

ordinary dock of stone; an important advantage in the arrangement of the structure of the dock being that all the necessary pumping required was done before a ship was put into it, the subsequent operation of lifting and drying her being effected by a system of valves made to shift and run off the water, thus obviating the possibility of interruption to the process of docking from accidents to or defects in the pumping machinery to which most docks are liable.

The building of the Bermuda was commenced in August, 1866, and she was to have been launched on the 3rd September, 1868, but on the dog-shores falling she did not move, and all the hydraulic power available at the time failed to start her, and there was no launch, as the tide began rapidly to recede. Better luck, however, attended the exertions made on the following day to induce the vast structure to take the water; after an interval of two minutes of intense excitement, the great fabric began to move on the application of enormous pressure, and gracefully glided into the river, appearing smaller and more small as she receded from its banks until her calculated water draught of 11ft. was reached, and she was safely riding on the water. She was subsequently towed to and moored in the Medway, where she was finally completed and prepared for her voyage across the Atlantic, which was successfully performed in the following year, the dock having left her moorings on the 23rd June, 1869, and sighted the Bermuda lighthouse in the morning of the 28th of the following month.

The surface condenser was in this case of the horizontal tubular type, the low-pressure cylinder exhausting directly into it. The engines were reverted by a small engine fitted on the top of the condenser, as shown in the illustration. All sizes of engines of this type, from 800 to 1700 indicated horse-power, were built by the Messrs. Maudslay, from 1870 onwards.

A considerable number of simple expansive engines, similar to those illustrated in Fig. 103, having been built while steam pressures in marine boilers had been gradually increasing, many of them were converted into two-stage compounds by the addition of two small cylinders fitted on the top of the existing ones, a distance piece, or stool, being provided to support them, and at the same time allow room for the necessary piston-rod stuffing-boxes required. The arrangement of the engines after such conversion was known as "four-cylinder tandem compounds," and is illustrated in Fig. 105.

The distinguishing feature in this type of engines was that the steam at boiler pressure was first admitted to both the upper or "high-pressure" cylinders, and after use in them was exhausted by separate exhaust pipes, as shown, into the low-pressure steam chests, which acted as receivers, from whence it was distributed by the slide valves to the low-pressure cylinders, and was finally exhausted by separate pipes into the circular condenser shown.

Each engine had its own air, bilge, and feed pumps worked off its low-pressure piston-rod crosshead. The

Mr. Mumford is to be congratulated on the complete success of the largest installation of water-tube boilers yet constructed by him, and their necessary appurtenances.

## THE COAL STRIKE.

THE strike reached another and, it was believed, a hopeful stage on Saturday, when Sir Edward Fry arrived as Conciliator, deputed by the Board of Trade to act in friendly intervention between the coalowners and the colliers. Arriving in Cardiff, he first had an interview with the Workmen's Provisional Committee, but some of the members were absent on collecting tours. His private secretary next had a consultation with Mr. Dalziel, the secretary of the association, and these preliminary measures were followed by a private meeting between Sir E. Fry and Sir W. T. Lewis, the chairman of the association. At the close Sir E. Fry left for Bristol, and it was notified that there would be an adjournment until Wednesday. It was understood that in the meantime all necessary facts and figures would be arranged for inspection.

On Wednesday the adjourned meeting was held, when a full gathering of the members of the Workmen's Committee met in consultation. Business began at 10 a.m., and was held in strict privacy until 12.30, when another adjournment took place until the afternoon.

The committee decided to submit certain propositions to the employers, upon which negotiations by the committee without the Conciliator should be reopened, with the view of arriving at a settlement if possible. The secretary of the

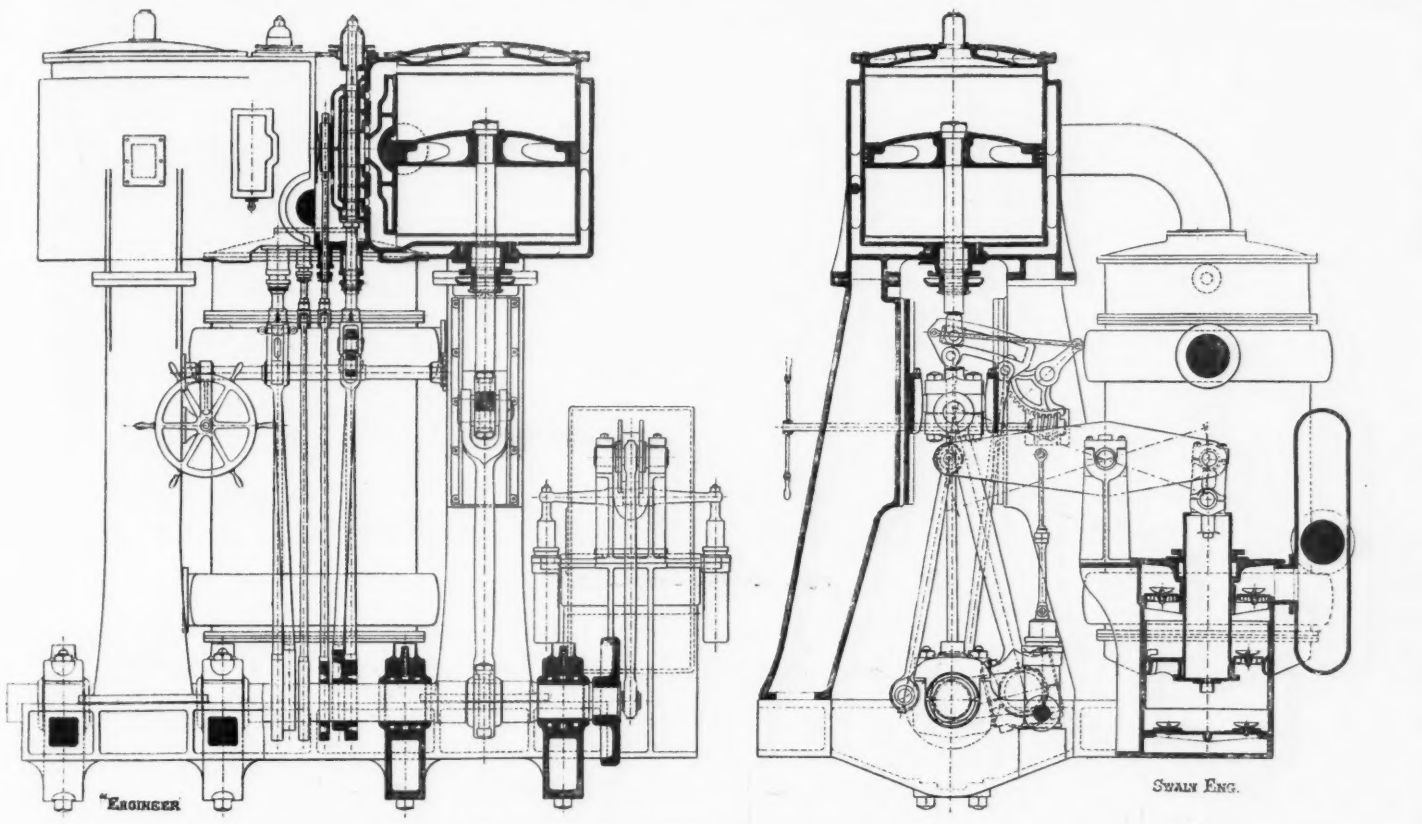



Fig. 103—MAUDSLAY'S ENGINES, S.S. LADY DERBY

As small, fast-running, yet powerful engines were one of "war's necessities" on shipboard in the early part of the last decade of the reign, it became inevitable on their introduction that some other means of generating high-pressure steam for working them was required than that offered by the old flat-sided box-boiler then in use. To meet this greatly-felt want, the round boiler with cylindrical fire-boxes was introduced and fitted by Messrs. Penn in 1855, and from that time forward, through the great improvements made in the constructive material and building of boilers, the cylindrical type of steam generator became by the year 1868 the only one in which a really high steam pressure could be raised with safety, this high pressure at that date meaning about 60 lb. to the square inch.

Such a pressure was used for some little time in the type of engines illustrated in Fig. 103, but it was soon found that for large powers it was not suitable in a single cylinder, even where surface condensation was practised, on account of the inequality of strains on the piston at the beginning and end of the stroke, and the greater strength—which meant weight—required in all the parts of the engine subject to the strain. To overcome these drawbacks "the two-stage" expansion, or compound engine, was devised, and soon came into general use. In Fig. 104 we give illustrations of a pair of early engines of this type, some twenty-six sets of them having been built and fitted by the Messrs. Maudslays, in 1869—70, to ships voyaging through the Suez Canal.

Their general arrangement is very similar to the engines illustrated in Fig. 103, the exception being that the cylinders are of unequal size, the steam at boiler pressure being first used in the smaller or "high-pressure" one, and after expansion in it being passed to the larger or "low-pressure" one; the power exerted in each being as nearly as possible equalised. Each cylinder was fitted with but one slide valve, worked with ordinary double excentrics and slotted links, the high-pressure valve being worked off the forward end, and the low-pressure one off the middle of the crank shaft.

crank shafts were in two lengths, coupled at the middle. Reversing was effected by a separate engine fitted on the top of the condenser. New engines of this type, specially designed for the purpose, of which our illustration is representative, were fitted by Messrs. Maudslay and Co. to the Britannic, Oceanic, Baltic, &c., of the White Star Line of Atlantic steamships, and were of from 3400 to 5400 indicated horse-power.

## H.M.S. SALAMANDER.

IN our impression for December 3rd, 1897, we illustrated and described very fully the water-tube boilers supplied by Mr. A. G. Mumford, of Colchester, to H.M.S. Salamander, and we expressed at the time a very favourable opinion of these generators, as giving a practical solution of the problem of large power marine boilers. We are happy to say that the soundness of our opinion has been fully demonstrated.

Her Majesty's cruiser Salamander has just completed a series of official steam trials in the English Channel, off Plymouth Harbour, to test the efficiency of her new water-tube boilers. In addition to the boilers, a complete set of auxiliary machinery has been fitted, consisting of four forced-draught fans, 6ft. diameter, driven by specially designed engines; two main feed pumps, and two auxiliary pumps, with steam cylinders 9in. diameter, pumps 6½in. diameter, with a stroke of 9in., of the vertical duplex type—Mumford and Anthony's patent—and four specially designed feed-water regulators, for the purpose of automatically insuring a constant and regular supply of feed-water to the boilers, also the joint patent of Mr. Mumford and Mr. Anthony. These we have fully described in the impression referred to above. The boilers, of which there are four, have each 2000 square feet of heating surface and 45 square feet of grate surface. They were designed to develope collectively 3500-horse-power under forced draught. The trials passed off in a most satisfactory manner, not a hitch occurring. On the eight hours' trial under natural draught the indicated horse-power developed was 2575. On the full power run of three hours' duration the horse-power developed was 4114—far in excess of the specified amount; this was obtained with an air pressure in the stokeholds of 2·6in. The vessel attained a speed of twenty knots.

workmen was then instructed to communicate with the employers' secretary, to arrange a meeting with the owners to discuss terms set forth in the secretary's letter. Pending this meeting the deadlock even more accentuated remains.

It was understood that the discussion in the morning between the Committee and Sir Edward had simply reference to the points submitted by them in support of their contention. There was no meeting of the Emergency Committee on Wednesday.

The following copy of a letter sent by Sir Edward Fry to the men gives the situation in a few words:—"Park Hotel, Cardiff, July 9th, 1898. Dear Sir,—Since seeing the members of your Committee this morning, Sir William Thomas Lewis has called upon me, at my request. He declined to recognise my position as Conciliator in any way, and stated that he called merely out of courtesy. He further stated that the associated employers declined to admit any intervention of a Conciliator, or any other person, appointed by the Government or otherwise; but that the associated employers are prepared to meet the authorised representatives of the men, but without the presence of a Conciliator. Sir William Thomas Lewis placed me at liberty to make such a use as I might think fit of this statement, and, accordingly, I communicate it to you for the information of your Committee. It appeared to me that, notwithstanding the attitude assumed by Sir William Lewis, I should meet your Committee as arranged. My postal address is 'Failand, near Bristol,' and my telegraph address, 'Abbotsleigh.'—Yours truly, Edward Fry."

The situation so far may be defined tersely as one in which the men will not give way, and the masters cannot.

The men employed at the Ystrad Mynach Colliery have resumed work on the masters' terms, namely, three shifts of eight hours. There are, therefore, no men drawn out, as was at first anticipated. The Lancarach Colliery is again getting its full quantity of men at work.

At a meeting of Celynen men on Saturday it was stated that at the recent conference in Cardiff it was arranged that out of the 20 per cent. contributed by colliers working to the relief fund, 1 per cent. would be deducted to fight the litigation cases arising out of the Compensation Act.

The strike has told strongly on recruiting, which has been and continues very brisk. The number of men accepted during the past six months nearly equals the record for the whole of 1897.

# SHIPBUILDING AND MARINE ENGINEERING ON THE THAMES

(*For description see page 54*)

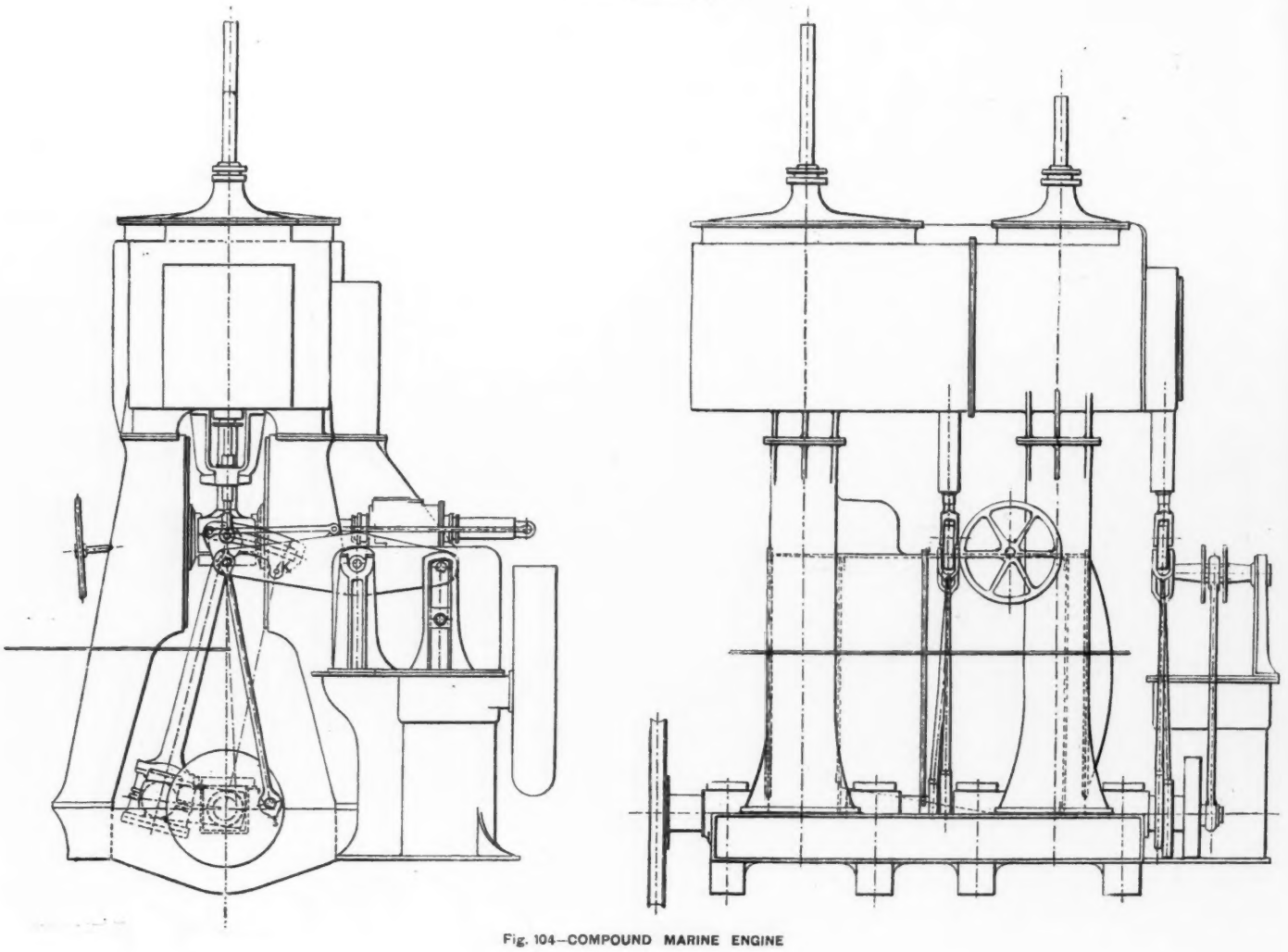


Fig. 104—COMPOUND MARINE ENGINE

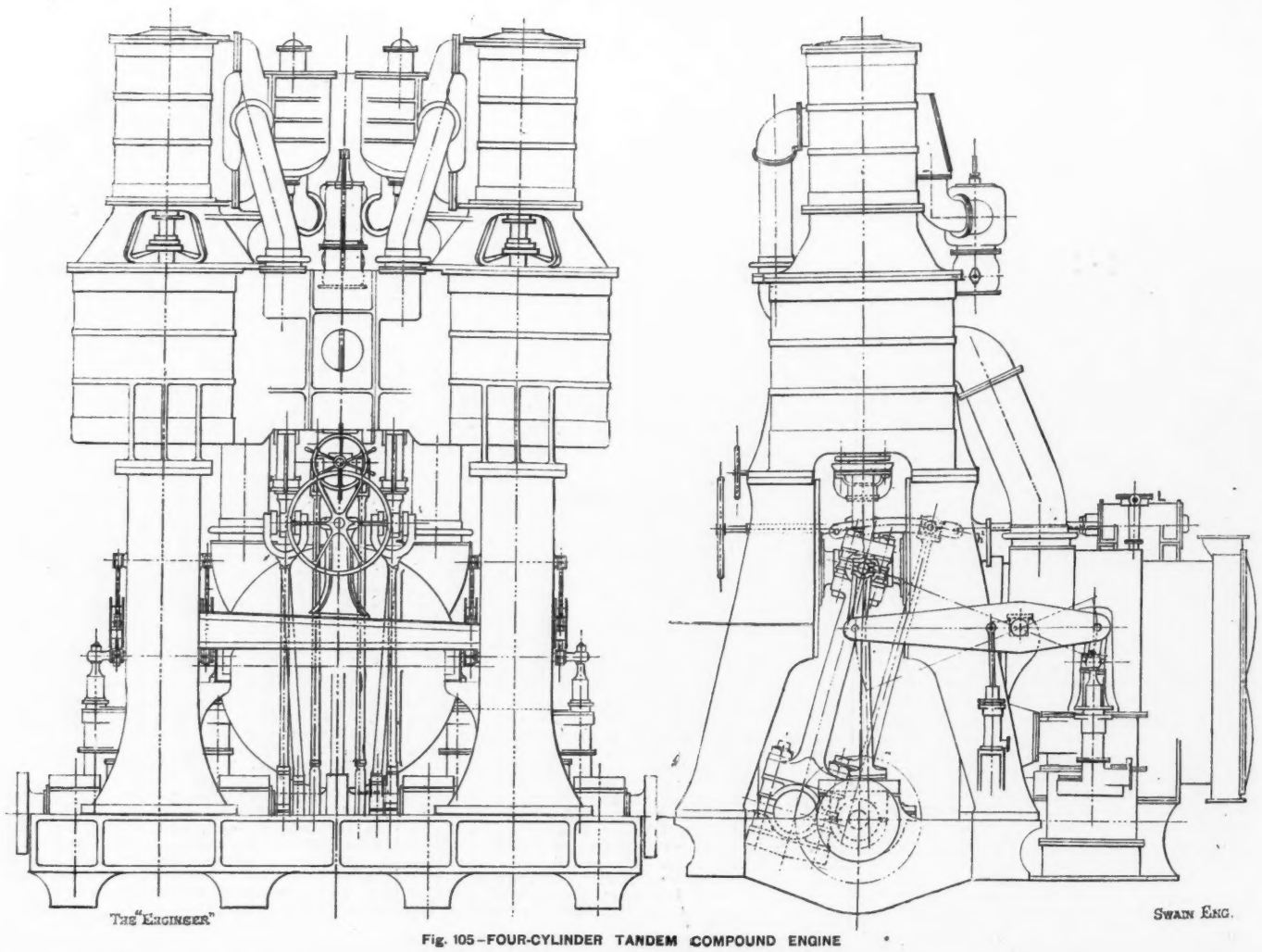
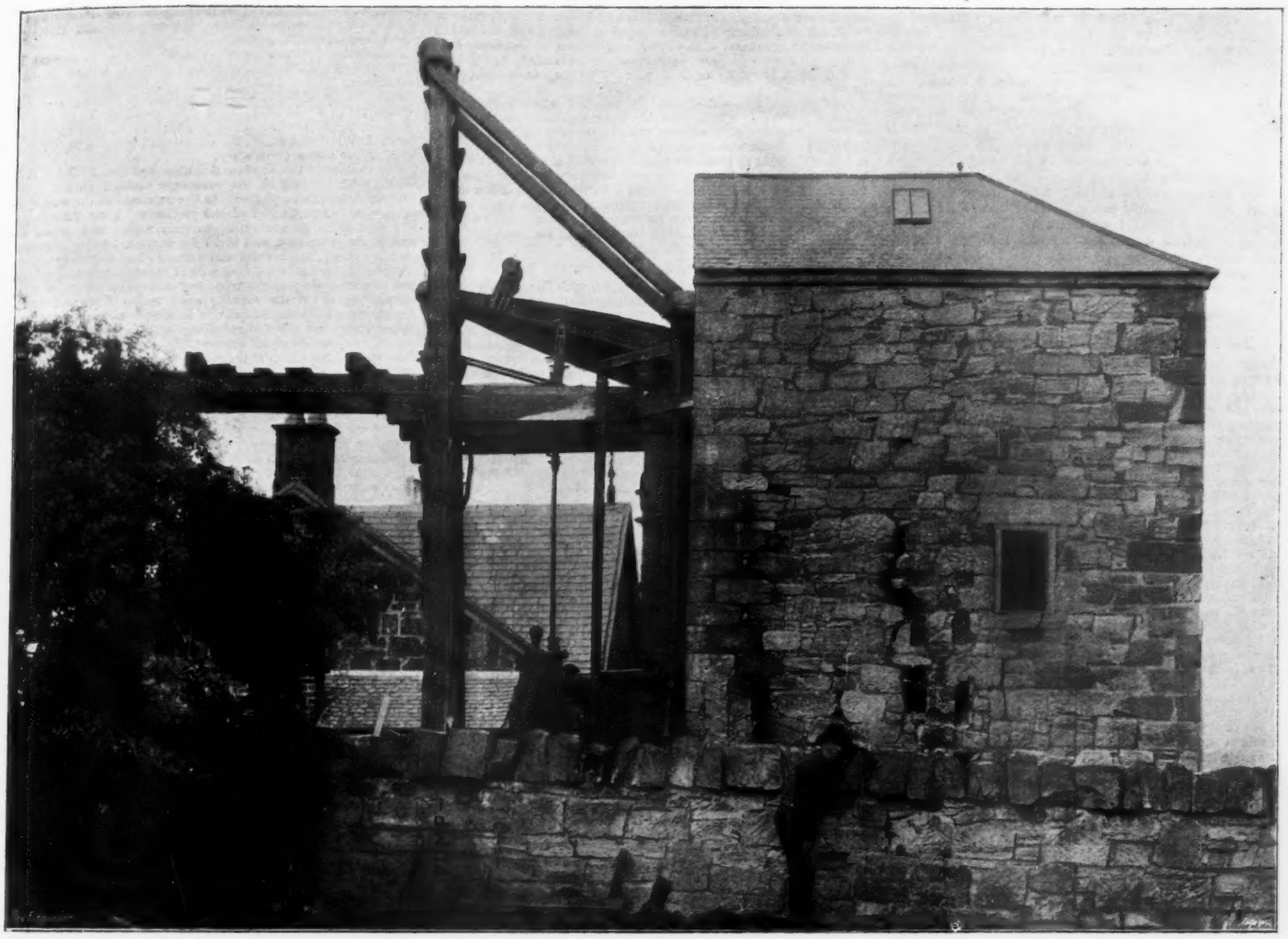


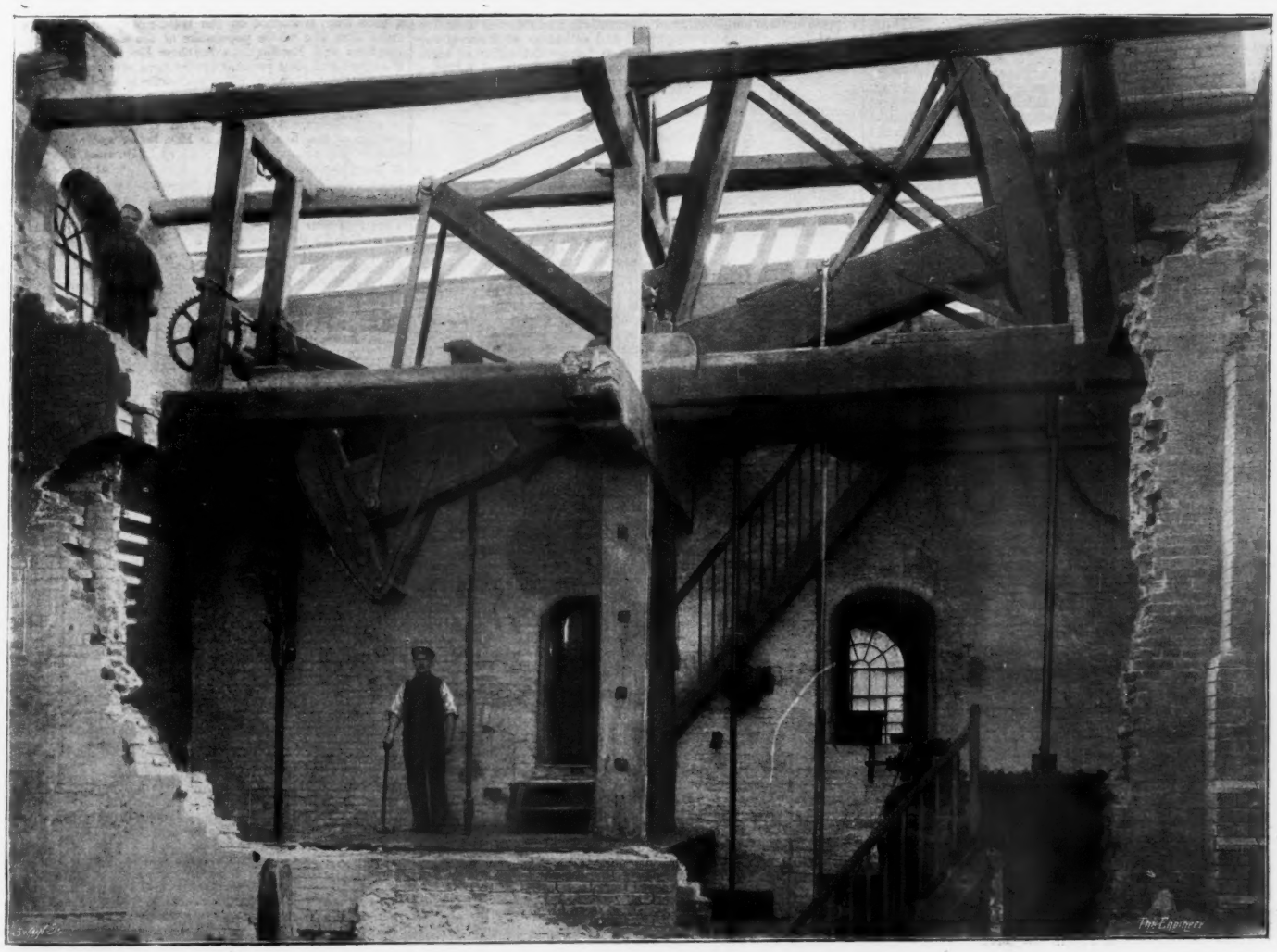

Fig. 105—FOUR-CYLINDER TANDEM COMPOUND ENGINE

# A PAIR OF OLD STEAM ENGINES

(*For description see page 65*)



NEWCOMEN ENGINE, CAPRINGTON COLLIERY, KILMARNOCK, 1808



BOULTON AND WATT ENGINE, BIRMINGHAM CANAL NAVIGATIONS, 1777

## MOTOR CAR NOTES.

As a result of the trials of motor wagons carried out recently at Liverpool under the patronage of the Liverpool and District Centre of the Self-propelled Traffic Association, the following resolution has been unanimously adopted by the Council:—"That the Liverpool Council of the Association is of opinion that the existing maximum of three tons tare imposed by the Locomotives on Highways Act, 1896, very seriously hampers, and in many cases prohibits, the construction of vehicles of the types required for the heavy traffic of this district, and a recommendation is hereby made to the General Council that the whole forces of the Association shall be immediately directed towards the obtaining of an amendment to the Act whereby (*a*) all restrictions upon weight shall be removed; or, if it be deemed inexpedient to remove all limitations, (*b*) a limit upon the total moving weight, or upon the weight per axle, shall be substituted for the present limit of three tons tare; or, if it be considered imperative to retain a limit upon the tare, (*c*) the tare permissible shall be increased to at least four tons." It is hoped that joint action will be taken shortly to give effect to one of these clauses.

## THE INSTITUTION OF MECHANICAL ENGINEERS.

THE following programme for the Derby meeting, 1898, has just been issued. The summer meeting of this Institution will be held in Derby, and will commence on Tuesday, July 26th. The following papers have been offered for reading and discussion, not necessarily in the order here given:—"Manufacture of Aluminium Articles, with Description of the Rolling Mills and Foundry at Milton, Staffordshire," by Mr. Emanuel Ristori, of London. "Water Softening and Purification by the Archbutt-Deeley Process," by Mr. Leonard Archbutt, Analytical Chemist, Midland Railway, Derby. "Mechanical Testing of Materials at the Locomotive Works of the Midland Railway, Derby," by Mr. W. Gadsby Peet, Chief of the Locomotive Testing Department. "Electric Current for Lighting and Power on the Midland Railway, and Driving Direct by Electric Motor without Shafting," by Mr. W. E. Langdon, Superintendent of the Electrical Department. "Narrow-gauge Railways, 2ft. and under," by Mr. Leslie S. Robertson, of London. "Results of Recent Practical Experience with Express Locomotive Engines," by Mr. Walter M. Smith, of Gateshead.

The directors of the Midland Railway Company have very handsomely granted to all classes of members of the Institution, as well as to those candidates whose names are in the ballot list, and to those also from whom completed proposal forms have been received, the privilege of free travelling during the week of the meeting between Derby and any one station on the Midland Railway, and in the various excursions to places on the line. To those staying in neighbouring towns the privilege of free travelling daily to and from Derby is extended. For these purposes special railway passes, available for use from Monday, July 25th, to Saturday, July 30th, inclusive, will be issued. These passes are not transferrable, but are personal to the individual members of the Institution. Ladies accompanying members will pay their fares; and a list of specially reduced fares will be announced in the detailed programme for those ladies who desire to participate in the various excursions.

*Monday, July 25th.*—The secretaries' office will be open from 3 p.m. to 6 p.m. in the Midland Railway Institute, Derby, for the registration of addresses, &c. Members' letters can if desired be addressed to the Institution of Mechanical Engineers, Midland Railway Institute, Derby; but preferably for their own convenience to their respective hotels. Mr. R. Mountford Deeley and Mr. George J. Pratt kindly act as honorary local secretaries. During the meeting the members are invited to avail themselves of the privileges of the following clubs, to which they will be admitted as honorary members:—Derby, Conservative, and Liberal clubs.

*Tuesday, July 26th.*—9 a.m.: Secretaries' office open in the Midland Railway Institute. 10 a.m.: Reception of the President, Mr. Samuel W. Johnson, and the Council and members of the Institution, in the Midland Railway Institute, by the chairman, Sir Ernest Paget, Bart., and the directors of the Midland Railway; by the Worshipful the Mayor of Derby, Alderman Frank Duesbury; and by the chairman, Sir A. Seale Haslam, and the members of the Local Committee. Reading and discussion of papers. 1 p.m.: Cold luncheon in the shareholders' room at the Midland Railway Station, Derby, by invitation of the directors of the company. 2 p.m.: Visit to Derby works open to the members. 6.30 for 7 p.m.: Institution dinner in a large new room in the carriage department of the Midland Railway, Derby. Evening dress. Tickets, exclusive of wines, &c., 7s. each, if paid for not later than July 13th; after that date 10s. each, to the extent of the accommodation available. So long as this has not been filled up before July 13th by members taking tickets for themselves, they can obtain tickets for friends, whose names should be given in the application. Intimations of mutual wishes on the part of members to be seated near one another will receive attention, as far as practicable in the arrangement of the table plan. To suit the convenience of members returning to Matlock after the dinner, a special train will be run.

*Wednesday, July 27th.*—9 a.m.: Secretaries' office open in the Midland Railway Institute. 10 a.m.: Reading and discussion of papers, Mr. Samuel W. Johnson, President, in the chair. 1 p.m.: Cold luncheon in the shareholders' room at the Midland Railway Station, Derby. Tickets, exclusive of wines, &c., 2s. 6d. each, if paid for not later than July 13th, after that date 3s. 6d. each. 2 p.m.: Visits to Derby works open to the members; 2 p.m.: Alternative excursion to Burton-on-Trent by special free train, on the invitation of Messrs. Bass, Ratcliff, and Gretton, to visit their brewery. Return train from Burton-on-Trent at 5 p.m., arriving 5.17 in Derby. 1.35 and 3.15 p.m.: Alternative excursion to Duffield to see the model railway in the grounds of Duffield Bank, by invitation of Sir Arthur Percival Heywood, Bart. In these two visits members may be accompanied by ladies, for whom railway tickets at reduced fares may be obtained at the railway booking-office. 8.30 p.m.: Conversazione in the Derby Free Library and Art Gallery, by invitation of the Local Committee (evening dress). To suit the convenience of members returning to Matlock after the Conversazione, a special train will be run.

*Thursday, July 28th.*—8.30 a.m.: Secretaries' office open in the Midland Railway Institute. 8.40 a.m.: Arrival of train from Matlock. 9.0 a.m.: Alternative excursion to Loughborough; special free train by invitation of the directors of the Midland Railway. Visit the works of the Brush Engineering Company. Thence by contractors' train over the new Great Central Railway to see the new Swithland Waterworks of the Leicester Corporation. Light refreshments, by invitation of Mr. Alderman Wood, Chairman of the Waterworks Committee. Special free train to Derby in time for cold luncheon at 2.0 p.m. Tickets, exclusive of wines, &c., 2s. 6d. each, if paid for not later than July 13th; after that date 3s. 6d. each. Thence special train at 3.0 p.m. to Nottingham. Members may be accompanied by ladies, for whom railway tickets at reduced fares may be obtained at the railway booking-office. 9.0 a.m.: Alternative excursion to Stoke-upon-Trent and Milton; ordinary train from Derby Station, Midland Railway. Visit Messrs. Minton's china works, and by train to Milton to see the British Aluminium Works. Luncheon can be obtained at the North Stafford Hotel, Stoke. Ordinary trains from Stoke at 11.43 a.m. and 2.13 p.m., for Derby and thence to Nottingham. Members may be accompanied by ladies. 9.0 a.m., 9.30 a.m., or 10.25 a.m.: Alternative excursion to Nottingham. Ordinary trains—free—from Derby Station. Visit works. Cold luncheon at the George or Albert Hotels. Tickets, exclusive of wines, &c., 2s. 6d. each, if paid for not later than July 13th; after that date 3s. 6d. each. Members may be accompanied by ladies, for whom railway tickets at reduced fares may be obtained at the railway booking office. 3.30 p.m. to 7.0 p.m.: Reception and garden party at Nottingham Castle and Museum, by invitation of the President, Samuel W. Johnson, Esq. (morning dress.) This invitation is extended to ladies. 7.15 p.m., 8.25 p.m., or 9.18 p.m.: Ordinary trains—free—to Derby.

*Friday, July 29th.*—8.30 a.m.: Secretaries' office open in the Midland Railway Institute. 9 a.m.: Excursion to Creswell Colliery and village by special free train. Members may be accompanied by ladies, for whom railway tickets at reduced fares may be obtained at the railway booking office. 10 and 11 a.m.: Drive through the Dukeries. Cold luncheon at Welbeck Abbey, by permission of his Grace the Duke of Portland, G.B.V.O. 6.15 p.m.: Plain tea at Mansfield. 7 p.m.: Special free train from Mansfield, arriving at 8 p.m. in Derby. Tickets for the drive, cold luncheon—exclusive of wines, &c.—and plain tea, 11s. each, if paid for not later than July 13th; after that date 15s. each.

### SYLLABUS OF PAPERS.

"Manufacture of Aluminium Articles, with Description of the Rolling Mills and Foundry at Milton, Staffordshire," by Mr. Emanuel Ristori.—This paper takes up the subject of aluminium where it was left at the Belfast meeting. British Aluminium Works at Milton; casting, refining, and rolling of aluminium plates. Various uses for aluminium, including marine engine and launch building. Uses of aluminium alloys, and their various properties.

"Water Softening and Purification by the Archbutt-Deeley Process," by Mr. Leonard Archbutt.—Chemical principles involved in the softening of water. Properties of softened water. Mechanical operations involved in softening. Archbutt-Deeley process. Treatment of river Derwent water in Midland Railway works. Results obtained with magnesia waters. Softening of water containing iron at Milton Waterworks, near Derby. Cost of softening. Advantages. Clarification of manufacturers' waste water.

"Mechanical Testing of Materials at the Locomotive Works of the Midland Railway, Derby," by Mr. W. Gadsby Peet.—Mechanical testing for commercial purposes. Whitworth 50-ton hydraulic testing machine; experiments to ascertain errors due to friction of cup-leathers, &c. Statical friction between lubricated metallic surfaces. Methods of holding test-pieces. Hand pump, power pump, and oil accumulator for applying pressure. Tests of copper and bronze alloys at various temperatures. Deeley torsion machine; autographic apparatus with Crosby indicator. Description of specimens, including fractures of boiler plates, crank and straight axles, some showing internal flaws.

"Electric Current for Lighting and Power on the Midland Railway, and Driving Direct by Electric Motor Without Shafting," by Mr. W. E. Langdon.—Generating station at Derby, including engine-room plant, output, and lamps in use. Analysis and details of cost of working eleven separate installations on Midland Railway. Particulars of direct high-tension plants—2200 volts—at Leeds and Kentish Town. Power required to drive lathes, drilling machines, and shafting; detailed results.

"Narrow-gauge Railways, 2ft. and under," by Mr. Leslie S. Robertson.—Sir Arthur Percival Heywood's model railway of 15in. gauge on Duffield Bank estate. More recent similar railway at Eaton Hall. Woolwich Arsenal, Festiniog, Darjeeling, German military, and other railways. Conditions under which very narrow-gauge railways may be advantageously used. Considerations determining most suitable gauge. Permanent way. Locomotives and other rolling stock. Transhipment. Financial aspect. Conclusions.

"Results of Recent Practical Experience with Express Locomotive Engines," by Mr. Walter M. Smith.—Preparatory work for trials on North-Eastern Railway, between Newcastle and Tweedmouth. Coal used. Particulars of train. Instructions to drivers. Time records, gradients, and curves of line. Particulars of five express engines employed, and observations made during their five round trips. Indicator diagrams, and estimates of horse-power developed at various points on each trip. Estimates of train resistances. The paper is accompanied by a number of tables, a complete dynamometer diagram from Newcastle to Tweedmouth; together with speed, gradient, curve, and other diagrams, showing conditions under which the trials were made.

## THE BOARD OF TRADE AND RAILWAYS.

THE following letter has been addressed by the Board of Trade to the general managers of railways:—

"Board of Trade (Railway Department), 7, Whitehall-gardens,
London, S.W., July 12th, 1898.

"Sir,—I am directed by the Board of Trade to state for the information of the directors of ——— Railway Company, that in May of last year the President appointed a Committee to inquire into questions relating to Railway Passenger Communication, and the Report of this Committee has now been issued as a Parliamentary Paper, No. C 8918. It will be seen from this report that the Committee unhesitatingly condemn as inefficient the outside cord system of communication, and do not regard as satisfactory methods of communication by pulling a cord or wire passing inside the carriages. They, however, hold that the principal electrical systems and the method of communication by means of a partial application of the brake may be taken as efficient. The views expressed by the Committee as to the inefficiency of the outside cord communication are fully shared by the Board of Trade, who have for years refused to approve it. The Committee recommend that the law should be extended so as to require the provision of means of communication on all passenger trains, irrespective of the distance run without a stop. The Board of Trade attach great importance to the conclusions of the Committee, and they have no doubt that those railway companies by whom the cord system is still used will at once take steps to substitute for it a proper means of communication, and that the companies, as a whole, will extend the provision of such a means to all passenger trains without waiting for an alteration of the law. The Board will be glad to be favoured with the observations of the directors of your company on the subject, indicating the steps which they propose to take. The Board have addressed a similar communication to the other railway companies in the United Kingdom.—I am, Sir, your obedient servant, "COURTENAY BOYLE."

OPENING OF NEW SEWAGE WORKS.—The new sewage purification works of the Uxbridge Urban District Council, the effluent from which finally enters the Thames, were formally opened on the 9th inst. by Sir Frederick Dixon Hartland, M.P., in the presence of the Council and their engineer, Mr. C. Nicholson Bailey, of Westminster. The sewage is pumped into precipitation tanks after treatment with Ferozone and then flows on to filter beds containing a layer of the powerful filtering material "Polarite." The effluent was found to be of such a high degree of purity that several of the visitors did not hesitate to taste it. Sir Frederick Dixon Hartland, as Chairman of the Thames Conservancy, congratulated the Council upon the improvements effected. It may be mentioned that the sewage of Uxbridge was formerly treated in covered tanks without the use of chemicals, and then passed through coke filters, but the results were so unsatisfactory that a modern system had to be adopted.

## SOCIETY OF ENGINEERS.

AN extremely interesting visit was made by a party of the members of the Society of Engineers on Wednesday, July 13th, to the London, Brighton, and South Coast Railway Locomotive Works at Brighton, the Brighton Marine Palace and Pier Works, Volk's Electric Railway, the Brighton and Rottingdean Sea-shore Electric Tramroad.

Among those present were:—Mr. W. Worby Beaumont, President; Mr. A. T. Walmisley, Past-president; Messrs. J. C. Fell and Charles Mason, Vice-presidents; Messrs. George Burt, D. B. Butler, Percy Griffith, and R. St. George Moore, members of council; F. W. Barclay, S. O. Cowper-Coles, T. F. Craddock, John Jones, N. Harker, Fred. Hovenden, E. Hulburd, R. J. G. Read, J. Waddington, W. G. Wales, and Weatherburn; and Mr. G. A. Pryce Cuxson, secretary.

The visitors to the London Brighton and South Coast Railway works, after arriving at the passenger station, passed along the East or Kemp Town platform to the entrance to the works, which is close to the north end of the platform. They then inspected the iron foundry, saw mills, carriage-fitting and wheel shops, smiths' shop, turnery, and brass foundry, returning through the erecting shop, boiler shop, and carriage-building shop. Crossing the line to the west side, they passed through the wagon-building and repairing shop to the trimming and paint shops, after which they returned *viâ* the running shed to the West or Portsmouth departure platform. About two thousand men are employed in these works, mainly for repairing and renewing rolling stock, which now consists of 461 engines, 2970 carriages, and 8693 wagons. New stock is built here at the rate of about 20 engines, 100 carriages, and upwards of 400 wagons per annum. Repairs to the machinery of the company's steamboats are also effected here as well as at the special workshop at Newhaven; also repairs to the hydraulic machinery in connection with the various goods depôts, together with work in connection with the numerous water supplies and pumping stations for supplying the line with water. Since the appointment of Mr. R. J. Billinton, there has been an installation of hydraulic machinery in the boiler shop, which latter has also been enlarged, and the roof raised for receiving the 12-ton overhead travelling cranes, driven by rope. The erecting shop has also been enlarged, and the overhead cranes, instead of being driven by shafting, have been altered and driven by rope, this work being carried out by Messrs. Craven Bros., Manchester. Since the last visit of the Society of Engineers, several new tools have been placed in the works for decreasing the cost of manufacture, and all of them have proved most efficient. The electric light has also been added to the station; this installation is worked from the shops, and the railway company is now about to lay down hydraulic machinery and cranes for working the enlarged goods yard. A large portion of the carriage stock is now lighted with compressed oil gas, and works have been erected for making and compressing this oil gas near the north end of the erecting shop.

The Brighton Marine Palace and Pier works were visited. This pier is practically opposite the entrance to the Aquarium, and about 150 yards west of the site of the chain pier, whose successor it really is, as the company had purchased the old chain pier, and entered into an agreement to pull it down on the completion of the new pier. The new pier, which is being constructed by Mr. John Howard, Westminster, from the designs and under the superintendence of Mr. R. St. George Moore, M.I.C.E., of Westminster, will, when completed, be 1750ft., or practically one-third of a mile long, and 45ft. wide at the narrowest point. There will be sufficient water at the landing-stage to enable Channel steamers to come alongside at all states of the tide. It is also proposed to erect on the pier a handsome pavilion, containing a concert hall, dining and refreshment rooms, shelter seats, and retiring rooms. The steam machinery for screwing the piles is also worthy of note, being capable of screwing a 12in. pile with a 2ft. 6in. screw blade 10ft. into the ground in an hour and a-half. Mr. W. Collins, the foreman in charge of the work, has succeeded with this machinery in erecting 60ft. of the pier in seven days.

Volk's Electric Railway is well known as the pioneer electric railway in the United Kingdom, having been opened before the Giant's Causeway Electric Railway. The line is three-quarters of a mile long, is worked on the third-rail system, and has carried more than the whole population of the county of London. The Brighton and Rottingdean Seashore Electric Tramroad is one of the latest and most peculiar applications of electric traction. The line is situated on the foreshore, entirely between high and low water, and extends from the Paston-place Groyne, within the Borough of Brighton, to Rottingdean—a distance of two miles seven furlongs. At high water of spring tides, at the deepest portion of the line, the rail is 15ft. below water level. The permanent way consists of four lines of 52 lb. steel flange rails, laid in pairs to a gauge of 2ft. 8½in., and to a total gauge between the outer rails of 18ft. The sleepers of ordinary railway practice are substituted by concrete blocks and large cast iron chairs, according to the nature of the ground. The car is carried on sixteen 33in. wheels in four bogeys, two of which occupy each a line of road, and are held in position by a strong steel framing. On each bogey stands a main steel tube column, from which spring the arched girders supporting the deck, which is 25ft. above rail level, and is 46ft. long by 22ft. wide. There is a deck-house, 25ft. long and 12ft. wide; when fully loaded it weighs about 50 tons. Mr. Magnus Volk, M.I.E.E., of Brighton, and Mr. R. St. George Moore, M.I.C.E., of Westminster, were jointly responsible for these works.

FLOATING BRIDGE AT CHATHAM.—The Royal Engineers completed on Tuesday a floating bridge over the Medway from Chatham Dockyard to Upnor Hard, which is contiguous to Upnor Castle. The river at this point is about a quarter of a mile wide, and the strength of the bridge was such that it might have carried an army, including its artillery. The site of the bridge was selected chiefly on account of the difficulties presented by the high river wall and deep mud on the dockyard side, says the *Times*. The width of the river, combined with the strong current and the passing traffic, were also regarded as useful educational factors, the officers and men engaged in the work being under instruction at the School of Military Engineering. At the dockyard end composite trestles were used for the approach, and at the Upnor end Weldon trestles, while between the bridge was carried on casks and service pontoons.

THE GUN TRADE AND THE PERSIAN GULF SEIZURE.—A meeting of the Birmingham Chamber of Commerce was held on Wednesday, Mr. F. B. Goodman presiding. The chairman said the gun trade had recently received a severe check owing to the sudden prohibition by the Government of the export of arms to the Persian Gulf ports. In December, 1897, large quantities of arms and ammunition which had passed through the Bushire Customs were received by the English Government and handed to the Persian Government, and the Baluchistan, with arms and ammunition, was seized by her Majesty's ship Lapwing and the arms and ammunition taken. The seizure was apparently made under the supposition that the arms were finding their way to the Afridis, but this view had been proved to be wrong. He moved that a memorial be transmitted from the chamber to the Secretary of State for Foreign Affairs setting forth the injury inflicted by the present seizure of arms at Bushire and in the Persian Gulf, and praying for an investigation of the circumstances, also expressing the hope that, in view of the fact that a large and increasing trade has been openly conducted for eighteen years without any interference on the part of either the English or the Persian Governments, the Government would give due consideration to the claims for compensation made by those firms whose trade had been stopped so suddenly. Mr. W. N. Whitehead seconded the motion, and said the duty had been accepted, so that there was no prohibition.

## RAILWAY MATTERS.

THE Chinese Government has received a telegram from the Chinese Minister in St. Petersburg announcing that Russia has withdrawn her opposition to the Northern Railway extension loan with the Hongkong and Shanghai Bank on learning that no mortgage upon the permanent way is given to the bank, and that the control of the line remains in the hands of the Chinese.

A SERIOUS railway collision took place on Wednesday at Larne Station, on the Belfast and Northern Counties Railway, by which fourteen passengers were injured. A passenger train from Belfast ran into an empty "special" through missing the points. The force of the impact shot a saloon carriage attached to the empty train high into the air, and detached a number of other carriages, which ran for some distance in the direction of Larne Harbour. The saloon and another carriage were completely wrecked, and the first five carriages of the passenger train were also much damaged.

THE want of road and rail communication in North Formosa is perhaps the most serious obstacle to expansion of trade, and, what is of greater importance, the pacification of outlying districts. It is most regrettable that the projected railway between north and south is no nearer a commencement than it was a year ago, says Mr. Consul Bonar. It is indispensable for the Government to undertake its construction; a private company, like the "Formosa Railway Company" formed in Japan, and having no support in the island, is bound to be a failure. Roads leave the capital in every direction, but the method of construction makes them unsuitable for permanent traffic.

FROM the surveys carried out with a view to give the central provinces of India direct communication with the east coast, it appears that a line from Raipur to Vizianagram would be 304 miles in length, and an alignment has been found which would involve the crossing of only two rivers of any considerable size. It is anticipated that the Eastern Ghâts, which alone present any obstacle of importance, could be negotiated with a ruling gradient of 1 in 100 without encountering great difficulties. This is one of those big projects which will come to the front in due time, says *Indian Engineering*. A rough estimate of the the cost shows that 360 lakhs of rupees would have to be spent.

ACCORDING to a New York contemporary, the Westinghouse Air-Brake Company have bought out the Boyden Brake Company. The price named was 900,000 dols. The action of the stockholders of the Boyden Company closes one of the most notable patent cases in the history of the United States. The fight between the Boyden and Westinghouse companies was hotly contested. The Westinghouse, which had enjoyed a monopoly of the air-brake business before the Boyden invention, claimed that the latter was an infringement on their patent on quick-acting brakes. The case was taken to the Supreme Court of the United States, and the decision was rendered upholding the claims of the Boyden Company.

LONDON'S second electric railway was formally opened for traffic on Monday last by the Duke of Cambridge. This railway will, if we mistake not, form a highly appreciated connection between Waterloo Station, the terminus of the London and South-Western Railway, on the south side of the Thames, and the heart of the City. As we hope in an early issue to describe the principal features of this line, it will be only necessary at present to state that it is an underground railway of the same type as the City and South London line, which has been working so successfully for some years. Each line is carried in its own tunnel, which is 11ft. 6in. diameter, and built up in segments. It will be remembered that Mr. J. H. Greathead, whose decease we had to announce some time ago, was one of the consulting engineers to the line, the other one being Mr. W. R. Galbraith, M. Inst. C.E. The rolling stock has been supplied by the Jackson and Sharp Company, of Rochester, U.S.A.

THE Administration report on the railways of India for 1897—98, prepared by Mr. A. Brereton, the Director of Railway Traffic and Statistics, has been presented to Parliament. From this it appears that the total length of railways open and sanctioned on March 31st, 1898, was 25,454½ miles, being a net increase of 926 miles during the year. The total length of railways open for traffic on the same date was 21,156½ miles, being a net increase of 766 miles, leaving 4298 miles still under construction or sanctioned. The mean mileage worked during the calendar year was 20,531 miles, being an increase of 748 miles over the figures of the previous year. The gross earnings in 1897 amounted to Rs. 25,59,51,692, or Rs. 22,91,267 more than in the previous year. The working expenses amounted to Rs. 12,51,11,631, and absorbed 48·88 per cent. of the gross earnings, against 48·09 per cent. in 1896. The net earnings amounted to Rs. 13,08,40,061, being a decrease of Rs. 8,43,489. The statistical return on the capital expenditure, as entered in rupees in the books in India, was 5·04 per cent., against 5·20 in the preceding twelve months.

THE Light Railway Commissioners sat on Wednesday at the Town Hall, Wood Green, to consider an application by the Metropolitan Tramways and Omnibus Company, Limited, for powers to construct the London, Barnet, Edgware, and Enfield Light Railway. The original scheme was one of a very far-reaching character, comprising nearly thirty miles of railway in the outer district of North London. In the form in which it came on Wednesday before the Commissioners, however, it was reduced to a scheme of light railways from Wood Green to Enfield and Edmonton, and from Wood Green to Tottenham. These proposed railways formed a junction with the North Metropolitan Tramways at Wood Green, and were practically an extension of that system, over which running powers were proposed to be exercised. In this amended form the scheme was strongly opposed by the London County Council and the local authorities, who contended that these proposed light railways were nothing more than tramways, but without the right of the local authorities to purchase the lines. The scheme was, after some preliminary proceedings, withdrawn by the promoters.

A REPORT has been presented to the Board of Trade by Lieut.-Col. Addison, the assistant-secretary of the Railway Department of the Board of Trade, on his inquiry into the circumstances attending the collision which occurred on the morning of June 4th at Sheffield Station on the Great Central Railway. A passenger train from Doncaster, when entering Sheffield Station, came into collision with the rear of another train, which was standing at the down platform, and injured several passengers. The driver of the Doncaster train admitted that he had seen a green flag which was shown at a cabin outside the station, intimating to him the fact that the platform was more or less occupied. When within 30 or 40 yards of the Retford train, he applied the brakes with sufficient force to skid the wheels, but it was too late to save the collision. Colonel Addison reports that this driver was the person chiefly responsible for the accident, but his mistake did not amount to more than an error of judgment. "The inspecting officers have always insisted upon the necessity for carrying out with the utmost strictness the rule which requires a train to be brought absolutely to a stand when the driver is to be cautioned," but in this case there was direct conflict of the evidence as to the stopping of the Doncaster train. The driver, fireman, and guard maintained that the outer home signal was pulled off before their train had come to a stand, while the signalmen and a ground inspector were equally positive to the contrary. "This case shows once more," says Colonel Addison, "the need for extreme care on the part of the signalmen, and that nothing is gained in the long run in trying to save time by lowering the signal prematurely." He further recommends that trains should be kept outside the station until the platform is sufficiently clear to hold the incoming train, and that the level crossing for luggage at the station should be abolished.

## NOTES AND MEMORANDA.

AN Imperial Chinese edict, just issued, directs the Tsung-li-Yamên to establish a Patent-office, with a view to encouraging inventors.

THEORETICALLY a pound avoirdupois of calcic carbide should yield 5·89 cubic feet of acetylene gas, but in practice not more than 5 cubic feet is obtained.

THE illuminating power of oil gas can be practically doubled by mixing with about 20 per cent. of acetylene gas and compressing to twenty atmospheres. These are the conditions under which it is burned on the German State Railways.

THE export of raw iron from England to Germany during 1897 amounted to 348,682 tons, compared with 324,370 tons in 1896. The enormous development of the iron trade in Germany would have led to a still greater demand had not the Lorraine and Luxembourg iron entered largely into competition.

THE total imports of Egyptian cotton into the United States for the season ended in September, 1897, were 79,385 bales, as against 59,339 bales in 1896. Of these 49,303 bales were entered at the port of Boston. In the cotton industry of this district there are employed 869,473 spindles, divided amongst sixteen mills.

SCOTCH shipbuilders last month launched forty-eight vessels of 51,072 tons, of which nineteen, of 40,172 tons, were steamers, two, of 5880 tons, war vessels, nine trawlers, seven tugs, a dredger, three yachts, five barges and two stern-wheel steamers, against forty-six vessels, of 47,780 tons, in May, and twenty-eight vessels, of 31,963 tons, in June last year.

A NEW indicator for measuring the inertia of moving machinery was explained by Mr. Wilfred Lewis at a recent meeting of the Engineers' Club of Philadelphia. It consists essentially of a curved tube filled with water, except for a small bubble of air which moves back and forward in the tube with its acceleration and retardation, caused by the inertia of the body which carries the instrument. By means of a graduated scale placed beside the tube, the inertia may be measured.

DURING June English shipbuilders put into the water twenty-three steamers, a battleship, a pontoon, and a trawler, aggregating about 93,383 tons, against twenty-nine vessels, of about 71,610 tons, in the previous month, and thirty-three vessels, of about 61,091 tons gross, in June last year. For the six months English builders have launched 161 vessels, of about 400,879 tons gross, against about 322,420 tons in the corresponding period of last year. Two steamers, of 13,500 tons gross, were launched at Belfast. The total launches for the United Kingdom during the first six months of this year have been 368 vessels, of about 686,137 tons gross, as compared with 344 vessels, of about 521,969 tons gross, for the first six months of 1897.

AT a meeting of the Mersey and Irwell Joint Committee held last week in Manchester it was resolved that the consideration of the matter of the disposal of the effluents of the Manchester Sewage Works should be adjourned for six months. The Rivers Committee of the Corporation have decided to put down four small test filters in addition to those already in use. The experts have told the Rivers Committee that they believed the effluent could be satisfactorily treated on the 151 acres of land which the Committee already possessed. If the effluent did not prove satisfactory and the Local Government Board were not satisfied that the Corporation could treat their effluent on the land they now possessed, the Corporation would be prepared to give a pledge to buy the further quantity which the Board might consider to be necessary.

THE report of the Select Committee appointed to inquire into the sufficiency of the law relating to the keeping, selling, using, and conveying of petroleum and other inflammable liquids, and the precautions to be observed in preventing accidents, was laid on the table of the House of Commons on Wednesday. The following is a summary of the recommendations:—(1) That the present law affecting petroleum spirit, not being adequate for public safety, should be amended in the manner specified in this report. (2) To adopt a flash point of 100 deg., Abel close test, as the dividing line between petroleum oil and petroleum spirit. (3) Legislation, as specified in this report, to control the storage, transport, and sale of petroleum generally, and admixtures of the same with other substances, certain heavy oils being exempted. (4) To provide for an efficient system of testing. (5) To provide for adequate supervision and administration by local authorities. (6) That official inquiries be made into the causes of accidents arising from the storage, transport, or use of inflammable liquids. (7) Statutory powers to enable the Secretary of State to issue orders affecting the manufacture and sale of lamps. (8) To spread information among the public as to the nature of petroleum and the management of petroleum lamps.

THE Public Control Committee of the London County Council have received a letter from the departmental committee of the Home-office, which is considering the questions of the manufacture and supply of water gas, asking for the opinion of the Council on the subject. The public Control Committee now report that, having carefully considered the matter, they have come to the following conclusions, which they have communicated to the departmental committee:—(1) That considerable danger arises from the introduction of water gas in the process of the enrichment of coal gas; (2) that non-carburetted and non-odorised water gas should not be allowed to be used under any conditions, since it is devoid of smell which would give warning of any escape of the gas; (3) that 25 per cent. should be the maximum amount of water gas allowed to be introduced in the enrichment of coal gas, the proportion of water gas being ascertained by determining the amount of carbonic oxide in the enriched coal gas—coal gas enriched to this extent would correspond in poisonous character to the Dowson gas which is already in use for heating purposes and for gas engines, and would exclude the use of carburetted water gas; (4) that when it is proposed to supply poisonous enriched gas to houses and the interior of buildings a proper inspection be made of the service pipes by a responsible officer appointed by the local or other suitable authority, who should certify that the pipes are in a sound condition and that there is no escape of gas, and that the cost of such inspection be borne by the gas company.

AN interesting application of the principle of the rotating magnetic field to signalling apparatus is described in a recent issue of the *Electrician*. This signal system, due to Dr. L. Weber, is intended to replace the step-by-step devices now used for many purposes, but especially for the purpose of signalling between bridge or pilot-house and the engine-room on ships. Similar dials are used at the ends of the line in these devices, the signal being given by moving an index lever over the dial at the sending station, and causing a corresponding movement of an index hand over the revolving dial. In Dr. Weber's device the sending instrument consists of an endless resistance helix, arranged in a circular form on the dial, and wound on a resistance frame in the manner of a Gramme winding. This resistance is tapped at three equidistant points by three conductors, which are led to the receiving dial. Here they are connected in the three-phase star fashion with three radially-disposed magnets controlling a small two-pole armature of soft iron attached to an indicating hand. The current energising this receiving instrument is furnished and suitably distributed by the sending instrument already referred to by an index lever, pivoted in the centre of the resistance helix, and furnished at its ends with contact pieces touching on the opposite ends of a diameter of the resistance, these contact pieces being terminals of an electrical source, the current from which is differently distributed in the three circuits, and therefore in the magnets of the receiver with every different position of the transmitter lever.

## MISCELLANEA.

THE following appeared in the German papers under date June 20th:—"Leipzig, June 20th, the Reichsgericht decided to-day in favour of the inventor Otto Schlick in the well-known patent lawsuit Schichau *versus* Vulcan."

A NEW industry has been started at Tamsui, a port of North Formosa, by a British company, which has erected buildings and godowns for the manufacture of tins, and the storage in them of Russian oil shipped there in bulk. This oil, though cheaper than American oil, does not seem so popular.

THE White Star Steamship Company is having bilge keels fixed on the twin-screw steamer Teutonic. Some time ago it fitted its cargo steamers with such preventives against rolling, and the application of side keels to one of its crack passenger boats serves to illustrate the popularity which these aids to comfort have attained.

AN electric tubular post, the invention of Dr. Alfred Brunn and Herr Viktor Takács, of Budapest, has been submitted to the Hungarian postal authorities. It has been decided to lay down a trial line from the eastern to the western railway stations in Budapest, and, if a year's working proves successful, the postal authorities will take over the line, and a scheme for connecting twenty-three offices on both sides of the Danube will be carried out.

NEW tube works are about to be laid down at Coatbridge on a site leased from Messrs. William Dixon and Co., Limited, of Calder Ironworks, lying close to the two competitive systems of the Caledonian and North British Railways. The new company starting the works, to be known as the Clydeside Tube Company, include two gentlemen, Messrs. Brown and Wotherspoon, who are well known in the commercial world, have large experience in the tube trade, and have for many years been closely identified with the firm of A. J. Stewart and Clydesdale, Limited, which was some time ago merged with Messrs. Menzies and Co., tube makers, and is now known as A. J. Stewart and Menzies, Limited. The Clydeside Tube Company intend to make a speciality in solid drawn tubes, such as are now so largely in request for water-tube boiler manufacture, as well as the higher class of welded tubes. The works will give employment to a large number of workmen.

IT is somewhat curious that on more than one occasion recently ships should have attempted to launch themselves. The Albion is said to have moved 2in. before the dog shores were knocked away, and this liveliness on her part was doubtless one reason why she was not properly named. The Fourth of July, too, launched at the Walker Yard of Armstrong's, started herself, and made her way into the Tyne at such a pace that all efforts to catch her or baptise her were fruitless, and she launched herself without a name. Seeing that this cruiser is for sale, it is quite possible that she may yet be re-named. As she is a sister ship to the Takasago, a vessel which so many of the Admiralty critics have declared to be better than any British cruiser of the same displacement, the *Army and Navy Gazette* suggests that our Government might do worse than acquire her. There would then be an opportunity for making a series of comparative trials with one of our own ships, which could not fail to be most interesting and instructive.

THE House of Lords Standing Committee met on Tuesday, under the presidency of the Earl of Kimberley, and considered the Locomotives on Highways Bill, which has passed its second reading, and which is concerned with heavy engines only, and does not affect light locomotives as defined in the Locomotives on Highways Act, 1896. Its object is to remove vexatious restrictions on the use of traction engines, while at the same time giving protection to ratepayers and others interested in the maintenance and use of highways. Lord Harris, who represented the Local Government Board, moved a new clause providing that the weight unloaded of every wagon drawn or propelled by a locomotive should be conspicuously affixed thereon, and also providing penalties for non-compliance and for fraudulently affixing incorrect weights. The Earl of Northbrook, who was in charge of the Bill, said he had no objections to the amendment, which was agreed to. On the motion of Lord Harris, an amendment was inserted requiring every locomotive to be licensed by a county council, but exempting agricultural locomotives, any locomotive not used for haulage purposes, any steam roller, and any locomotive belonging to a road authority when used by them within their district. Several drafting and other amendments were also agreed to

STATEMENTS are frequently made in and out of the Press on the subject of the proportion of seamen and stokers who leave the Navy after their first period of engagement has come to an end. Such statements more often than not are made on insufficient grounds or based on returns which are out of date. It is well, therefore, that the parliamentary return of 1894 on this subject should have been supplemented by further figures. This return shows, as near as it is possible to do so, the percentage of seamen and stokers who, on the termination of their first engagement, (A) re-engage at once; (B) leave, but return within twelve months; (C) leave, but return after twelve months; (D) leave, and do not re-engage. We do not understand why the figures go no further than 1895, but in that year they show that of the seamen 65·8 per cent. re-engaged at once, that is to say, more than half, while only 22·6 per cent. did not re-engage at all, the balance re-engaging after a certain period on shore. It was contended in Parliament only the other day that owing to their treatment, or ill-treatment, in certain respects, very few stokers re-engaged at all, but from the parliamentary return it appears that no less than 83·4 per cent. re-engage at once, and only 6·8 per cent. quit the Navy for good after their first period of service. That about one-fifth of the seamen class do not re-engage at all is probably due to the fact that they have acquired experience which enables them to command a higher wage in the labour market than it is worth the while of the Government to offer. Many of them, says the *Army and Navy Gazette*, are to be found in the employ of large private firms in most responsible positions. No one can quarrel with these men for thus bettering their position in life.

THE Government of India have sanctioned the purchase in India of articles made up from imported iron and steel without any of the former restrictions, except that in the case of all large engineering projects the articles required will be supplied from England on indent at their commencement. The list is a varied one, ranging from a girder bridge to a lamp-post. There are seven firms in Bengal, four in Bombay and Karruchee, three in Madras, two in Burma, and one in the North-West Provinces, who at present enjoy the privilege of tendering; but doubtless this number will be largely increased when a fresh demand arises for manufactured articles of iron and steel. The conditions of quality and test will be much the same as in England, and as most of the Indian engineering colleges—Madras, Seebpore, Bombay, and Roorkee—have testing machines and capable men to work them, there will be no difficulty experienced practically in applying the tests, says *Indian Engineering*. Another stipulation is, that the price and quality of the manufactured article is to be governed by that obtaining at home. The firms in India will now doubtless get a large number of orders, and it is hoped and believed that the resolution will be construed liberally and faithfully. It has been a sore point with them for a very long time that they have practically been prevented by the Government rules from obtaining any work from the State, except in extremely limited quantity and in exceptional cases. The large firms have again and again addressed the Government of India and the Secretary of State on the subject, but nothing was done until last year, when the case was taken up in the Public Works Department. Now private enterprise in India will have a better chance of showing what can be done in one direction at least.

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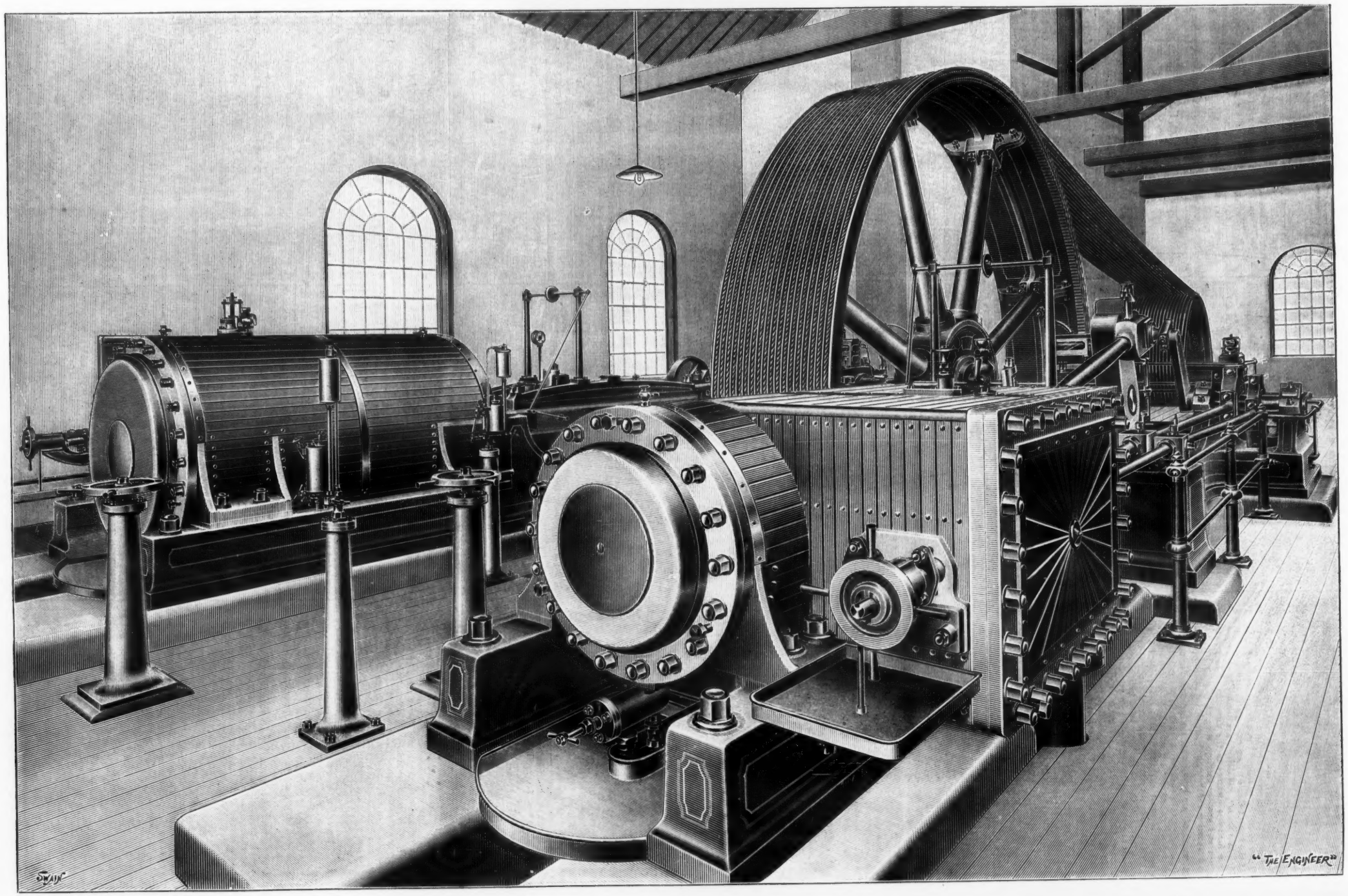
MESSRS. WALKER BROTHERS, LIMITED, WIGAN, ENGINEERS

(*For description see page 61*)



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*** *We cannot undertake to return drawings or manuscripts; we must, therefore request correspondents to keep copies.*

### REPLIES.

A. M. B.—We are much obliged by the information.

PETROL.—(1) The best answer we can give you is to refer you to the article on page 49. (2) We fear that the apparatus required to burn astaki would be far too cumbersome for a motor car.

T. W. (Brixton).—The new Patent-office Library will probably be opened next week. It is, however, only a temporary arrangement intended to hold good for about three years. During that period the building in Quality-court will be pulled down and rebuilt.

J. E. S.—There will be no difference. Theoretically, the higher the pressure the greater the quantity of fuel that will be burned, because the gases leave the boiler at a slightly higher temperature. The difference is, however, so small that in practice it may be regarded as not existing. In other words, the economy will be the same, no matter what the boiler pressure.

### INQUIRIES.

NEEDLE LUBRICATORS.

SIR,—Can any reader oblige me with the name of the makers of a lubricator which, instead of being provided with a needle, is fitted with a spiral wire for conducting the lubricant to the bearing? J. C.
Crouch End, July 8th.

# THE ENGINEER.

*JULY* 15, 1898.

### FRENCH COALING STATIONS.

THE appointment of M. Edouard Lockroy as Minister of the Marine has been made at a time when the incidents of the naval struggle between Spain and the United States seemed to have amply confirmed the wisdom of the policy which he advocated last year during the discussion on the Marine Budget. As is well known, M. Lockroy is very anxious to re-organise thoroughly the French navy upon the lines of the British marine; and his plan of action was fully set forth in these columns when the matter was occupying the attention of the Chamber of Deputies. The new Minister now finds himself in a position to carry out his scheme, if not wholly at least partially. His first move has been to invite the Cabinet Council to transfer the task of defending the Colonies and oversea possessions from the Colonial-office to the Marine Department; and the Council has requested the Minister of the Colonies to arrange with M. Lockroy on this point. After the opposition he has met with in the past from the respective Governments, M. Lockroy is probably surprised at the readiness with which the Cabinet has fallen in with his views. The Ministers have evidently been impressed as much by the recent experience of the Spanish fleets in both hemispheres as by the arguments of M. Lockroy, who has certainly made out a strong case in favour of centralising the defence of the colonial possessions. At present the whole of the money voted for this purpose passes through the hands of the Colonial Minister, who is more concerned with the commercial and industrial development of the oversea dependencies than with the putting of these countries in a proper state of defence, and M. Lockroy therefore argues that much of the money that is granted to the Colonies under the Marine Budget is devoted to other things. Consequently not only are the Colonies utterly destitute of satisfactory means of defence, but in the event of war there would be a division of responsibility between the Minister of the Colonies and the Minister of Marine, who would probably come into conflict, to the serious detriment of the country's welfare.

The seriousness of this possibility has been brought home to the French authorities by the blocking up of Admiral Cervera's squadron in the Bay of Santiago, and the loss of time involved to Admiral Camara's fleet in passing through the Suez Canal, on account of the difficulty of procuring coal supplies. It is therefore by no means surprising that the Cabinet should have welcomed M. Lockroy's scheme for the creation of the new bases of operation, for which last year he asked the Chamber to devote forty million of francs, or £1,600,000, out of a total grant of 260,000,000f. The most important of these are Dakar and Martinique, which will no doubt be the first to be fortified immediately the Minister of the Marine has the control of them in his own hands, and has obtained the funds for carrying out the work. These two points are held by the French authorities to be absolutely necessary to enable the fleet to be effective on both sides of the Atlantic. With Dakar as an impregnable station, the French would be able to cut the Atlantic routes north and south. Under the shelter of Cape Verde they would have command of the road to the Cape of Good Hope. They would be able to send their cruisers along the coast of West Africa, and would be in a position to coal the fleet in the event of its being compelled to go round, through the closing of the Suez Canal, to Madagascar and Tonkin. At present Dakar has no fortifications whatever. It is merely defended by a dismantled frigate, and the authorities say that the port would fall into the hands of an enemy in half an hour. At Martinique the port is not large enough for big cruisers, but the defensive works have been so far strengthened that it is expected the harbour would be safe enough for the smaller vessels. On the other hand, the island would be at the mercy of an enemy, who could easily take Fort of France from the rear, and once this was done the harbour fortifications would be useless.

In the Indian Ocean it is claimed that Diego-Suarez may be converted into an impregnable fortress; but the sea sweeps round with such force that navigation in that neighbourhood is very difficult, if not dangerous. Saigon is defended by the batteries of the Cape Saint-Jacques; but the artillery is mostly of an obsolete type, and unless it is replaced with more modern engines of war, it is believed that a hostile fleet would have no difficulty in forcing its way into the harbour. It is probable also that Noumea in New Caledonia will be fortified, in order to provide a basis of operation in the Pacific. In the Mediterranean, the object of M. Lockroy is to destroy the strategical value of Gibraltar. He favours the plan of Admiral Aube of converting Rachgoum into a nest of torpedo boats and destroyers, which would close up the straits to a hostile fleet. Corsica is to be defended, if possible; but neither Bonifacio nor Ajaccio can be sufficiently fortified, and it is difficult to see any other point which would serve as a safe refuge for the French navy. Finally, Bizerta is being strongly armed, and will in course of time become as important a basis of operation on the south of the Mediterranean as Toulon is on the north.

It will thus be seen that the programme of M. Lockroy is vast. As he possesses unlimited confidence in his ability to carry out the task, there is no doubt that he will accomplish a great deal; but it is fairly certain that he will find the difficulties of the undertaking more serious than he expects. An enormous sum of money will be necessary to fortify all these places. The sum of 40 millions of francs that he suggested last year should be devoted to these works is ridiculously inadequate; and, in the present state of the Budget, even this amount would mean a great sacrifice. It is therefore not easy to see how the country will be able to provide the funds necessary for carrying out the whole of the scheme brought forward by the new Minister. Many of his ideas are being strongly combated by experts; notably, the proposed creation of a torpedo station at Rachgoum, which can never be more than a costly experiment, and will certainly have little effect in nullifying Gibraltar. In any event, M. Lockroy finds himself in an excellent position for carrying out his pet scheme, as far as the finances of the country will permit him to do so, and the discussion upon the next Marine Budget is likely to be interesting and instructive.

### THE LOSS OF LA BOURGOGNE.

THE terrible disaster that occurred to the French transatlantic passenger steamer La Bourgogne, on Monday week, makes an appalling addition to the already painfully long record of ocean tragedies. Whether or not the time will ever come when travel on the seas will be wholly free from the risk of foundering from collision it is impossible to say; but certain it is that there are many vessels crossing the ocean to-day, with hundreds of souls on board, that would be sent to the bottom in a very few minutes after receiving a blow from a floating body even less in bulk and weight than a Thames barge. That this should be so is both humiliating and inexcusable in view of the possibilities offered by the present state of naval science. It is not suggested that the Bourgogne disaster is a case of this kind, although the circumstances attending it do not point to an elaborate arrangement of watertight sub-division, such as alone is sufficient to keep a vessel afloat when badly damaged through collision.

La Bourgogne was a screw steamer 494ft. long by 52ft. wide, and a registered depth of 34·4ft. She was built of iron and steel, being fitted with three decks and a shade deck, and her tonnage was 7395 tons gross, and 2985 tons net register. Her owners were the Compagnie Générale Transatlantique, of Havre, and she was built in the year 1885 by the Forges et Chantiers de la Mediterranée at La Seyne. The Bourgogne has been engaged ever since her construction in the passenger trade between Havre and New York, and on sailing from the latter port upon Saturday, the 2nd of July, had in all 714 souls on board.

It seems that early on Monday morning, when about sixty miles from Sable Island, and therefore not far from the coast of Nova Scotia, the vessel entered one of those very dense fogs which are so commonly experienced off that part of the North American shores. It is said that the speed was then reduced, but there is some uncertainty on that point. The sound of a fog horn was heard through the mist, and suddenly the officers in charge found their ship in collision with an iron sailing vessel which struck her on the starboard side, about amidships. Regarding what followed there have been a number of conflicting statements published. From one account it would appear that the vessel remained afloat for fifty minutes after the collision, while according to another statement the Bourgogne sank in ten minutes. In view of the enormous loss of life which occurred, the shorter period of flotation after receiving the fatal blow would seem to approximate more closely to the actual time. Of the 714 persons on board the vessel no less than 549 were drowned. That 104 out of the 165 persons saved should happen to be members of the crew, and that only one woman and none of the children on board are among the list of the rescued, is a circumstance not without its significance. The iron sailing ship with which La Bourgogne collided proved to be the Cromartyshire, of Glasgow, of 1550 tons gross register, and built by Messrs. Russell and Co., of Port Glasgow, in 1879. Notwithstanding that the Cromartyshire's bow was, according to the log entry, "completely cut off and the plates twisted into every conceivable shape," her collision bulkhead was sufficiently strong and water-tight to keep her afloat, so that she became the means of rescuing all the lives that survived the disaster. In this plight the Allan liner Grecian hove in sight, took from her the living remnant of the Bourgogne's human freight, and towed the Cromartyshire into Halifax.

Such briefly is the story of this, the latest ocean tragedy. There are, it is true, some ugly additions to the narrative to which we have not alluded further than

by calling attention to the disparity between the proportion of the passengers lost as compared with that of the crew. This is a subject which will doubtless receive full investigation, and, it is to be hoped, be adequately dealt with. If the statements made by the passengers prove on inquiry to be true, it is to be feared that the owners of La Bourgogne will not find their line of steamers increasingly used by Transatlantic voyagers. For the present, however, our chief interest is centred in the cause of the collision and in the terrible disaster that followed. The Cromartyshire was, it is said, sailing at about four or five knots an hour, and considering that fogs are not usually associated with much movement of the air, it is doubtful if even she were sailing so fast as that. Being in a fog, she had probably no more speed than was necessary to give her steerage way in the event of a vessel suddenly becoming visible. La Bourgogne was a vessel of about 17 knots speed, and whatever may have been the rate of her progress when she came upon the Cromartyshire, it was evidently enough to smash the bow of the sailing ship and tear a large hole in her own side. Without wishing to anticipate the decision of a court of inquiry, or to prejudge the case in any way, we may yet allow the facts thus far to speak for themselves. Moreover, the two vessels lost sight of each other directly after the collision, which shows that one at least had considerable way on her when they collided.

The effects of the collision tend to show that the tracks of the two vessels were not quite at right angles to each other, and that the stem of the Cromartyshire penetrated the side of La Bourgogne at the cross bunker, just on the foreside of the forward stokehold. But the speed at which the steamer was travelling doubtless caused the stem of the sailing ship to make a succession of blows, and thereby penetrate the foreward stokehold also, and perhaps the after stokehold besides. Such a grazing or ricochet collison would admit water into two compartments having a united length of about 100ft., and perhaps into three compartments of a united length of 160ft. That the first blow was received in the bunker, and the largest hole torn at that place, seems to be borne out by the circumstance that the first rush of water into the stokeholds was not so considerable as to deter the chief engineer from hoping that they might reach Sable Island before the vessel sank. The nature of the damage to the Cromartyshire is corroborative of the sequence of events we have suggested. Had the Cromartyshire been moving swiftly through the water, she would have buried herself so deeply into the side of the steamer as to have torn her shell plating abaft the collision bulkhead. But that the bulkhead was not only intact, but water-tight also, shows that the damage to the bow was confined to a comparatively short length of the vessel, and certainly to less than 18ft. Of the actual number of La Bourgogne's transverse water-tight bulkheads we are without trustworthy particulars, but it would appear that they were about nine in number, extending to the upper deck, and two others extending to the middle deck. This would give the vessel twelve water-tight compartments as high as the middle deck, and ten to the upper deck. Such a subdivision is far in excess of what is given to an ordinary cargo steamer, but less than is provided in our more recently built British vessels engaged in the Transatlantic passenger service. For instance, the Campania and Lucania, with a length of 600ft., have twelve transverse water-tight bulkheads extending to their upper decks, while the New York and Paris, which are 527ft. in length, have no less than fifteen. It must, of course, be borne in mind that La Bourgogne was built thirteen years ago, when so much attention was not being given as at the present day to the question of obtaining passenger safety in ocean steamers by means of extensive water-tight subdivision. At the same time it cannot be said that her bulkhead subdivision was inconsiderable, even if it proved inadequate under the circumstances attending the disaster.

It is perhaps impossible to provide against every contingency that may occur in ocean navigation, but one would suppose it would be possible to build a passenger steamer in such a way that even if her side were torn through collision, she would yet remain afloat sufficiently long to enable the passengers to be transferred to the boats. La Bourgogne carried, it is said, twelve boats, but we do not find that many of them were launched, or that time was afforded for effecting a safe transfer of passengers into them. Of course, the story of an utter want of discipline of the crew, and the mad rush they made to save their own lives by keeping the passengers out of the boats, remains to be tested by investigation; but whatever may be true on that point, the fact remains that only one woman was saved, and she thanks only to the strength and courage of her husband. The Bourgogne case is, in truth, the most disquieting and, as yet, the least explained of the ocean disasters of many years past. It has been suggested that to bring her to the spot where she foundered her course must have been shaped unduly to the northward, and that this was probably done to shorten her track, even at the risk of encountering fog and ice. And then to sink within ten minutes of receiving a blow from a slow-moving sailing ship seems to indicate that she was steaming too rapidly in a fog. Whether she had too many water-tight doors in her bulkheads, or whether these doors could be quickly closed, or were closed, has not yet become known. It is to be feared that no subdivision into compartments, however extensive it be made, will suffice to ensure safety in case of collision so long as the bulkheads are pierced with so many doors as are found in most passenger steamers. It is quite true that the duties of stoking, &c., cannot easily be carried out without them, but if safety is made a *sine quâ non*, a solution of the problem can be found. And, after all, who would not rather cross the ocean in an unsinkable ship, even if she did arrive at her destination a few hours after a competitor in the same trade? Future travellers intending to cross the Atlantic will doubtless take a warning from the terrible catastrophe, and if in so doing they compel ocean steamship companies to use none other than the safest and most efficient vessels for their passenger carrying trade, the disaster will not have occurred in vain.

### THE NAVAL BATTLE AT SANTIAGO.

ALTHOUGH we are not sufficiently well informed as to many of the important conditions under which the American and Spanish ships fought, enough has come to us to make some matters of conjecture clear. First, the promptness with which the American battleships moved is explained, for it is now said that it had been apparent to them that the Spanish ships were getting up steam, and consequently they did the same. Stated in this way the matter is simple enough, but how came this about? It might be supposed that ships concealed in a harbour would have considerable advantage over those lying outside, and that aided by device there might be sufficient cover to enable them to get up steam unperceived by the enemy outside. Certainly it ought to have been apparent to the Spaniards that the American ships were getting up steam, and so had perceived their intention. It would need very peremptory orders indeed from home to prevent a certain amount of watching and making feints before leaving the harbour under such conditions. After some false alarms, the Americans might perhaps be caught unready. There seems opening for misleading an enemy under such conditions by burning wood or making smoke out of proportion to the expenditure of precious coal. Apparently, however, there was no thought of anything of this kind. The Admiral did not seem to consider that was his business. "His was to do and die, his not to reason why;" but if this is what a Government expects from an Admiral, it not only courts destruction, it positively acts like a set of madmen.

The next question that suggests itself is that of artillery fire. Has any explanation been given of the total disproportion in the effect of the American guns to that of the Spanish? Admiral Cervera now tells us that the Cristobal Colon had no heavy guns. Now, this was the particular vessel that we believed could be reckoned on. We had already learned that the Spanish resources in the present day fall as far short of their supposed extent as in the days of the Peninsular War; but the Cristobal Colon had been purchased from Italy, and, we imagined, in a complete state, furnished with all the latest appliances, including two 10in. new type guns and a powerful battery of ten 6in. quick-fire guns. Does Admiral Cervera include these latter in the term heavy guns? The absence of the principal guns is too awful to call for comment; but if the 6in. quick-fire guns existed, we do not understand why they did not make their mark on the enemy. What is true of the Cristobal Colon is true of the other ships in a less degree. The Vizcaya and Oquendo and Infanta Maria Teresa had together thirty 5·5in. guns, and the ten carried by the Vizcaya were said to be quick-firing. Supposing all the principal guns to miss, it is difficult to understand how such a volume of shot as the secondary batteries discharge should prove so harmless. Following this comes the extraordinary fact that the American ships produced the most terrible effect with their fire. Except the Brooklyn, they practically carry no quick-fire guns of the heavier and important class, which are mounted behind medium armour, and are, perhaps, the only quick-fire pieces which can be manned in close action. We can certainly recognise that efficiency and good gunnery tell tremendously even with slow-fire, but that it should so entirely overpower the fire opposed to it without suffering from any blows argues absolute failure on the part of the enemy.

So far as we can learn, however, there were one or two modern improvements which the Spaniards possessed. Apparently, they had smokeless powder, and this just the one that might probably have been dispensed with advantageously under the circumstances. Nay, apparently, had they fired a quantity of blank cartridge which made a thick smoke, they would have done the Americans nearly as much harm as they did, and perhaps made it more difficult to deliver well-aimed fire at them. Again, the Spaniards possessed torpedoes, but instead of being fired at the enemy they seem to have lain on deck and formed mines for the enemy's shells to explode. The Americans appear to be satisfied that evidence is thus furnished to lead to the abolition of torpedoes on men-of-war. This may be the case; indeed, it has long been known that they constitute a source of danger; but we must not argue too confidently from what happened in Spanish ships, where things seem to have been in such extraordinary condition. We may readily admit that a torpedo constitutes a source of danger when it is left lying about among men in a state of chaos exposed to a heavy fire. It is painful to dwell upon the shortcomings of the ships manned so gallantly, but the greater part of the faults lie at the door of the Government, not of those who came out so bravely to certain destruction.

Critics are disappointed in the lessons taught by the war, and they may well be so, for if we enumerate them they are surely not such as we ought to need. For example, it has been shown that (1) A small fleet ought not to go out to seek a harbour as the focus of war operations, and remain there until the enemy, hitherto scattered, muster in such force as to be able to crush it easily. (2) That under these conditions it is better that the admiral in command should have some discretion as to coming out to meet an enemy that is in such overpowering force. (3) To make a dash through a superior fleet, it is desirable to secure the lead in getting under steam. (4) It is no use reckoning on nominal superiority in speed if the bottoms of the ships are foul to an aggravated extent. (5) A ship loses in fighting power if she omits to take her principal guns on board. (6) Shot that only strike the water and make splashes produce no real effect on an enemy, unless he is strangely nervous, consequently even quick fire is no use unless well directed. (7) Under some conditions smokeless powder may be a disadvantage. (8) Torpedoes should not be left about exposed under a hot fire. (9) And by no means least, the whole success of naval operations depends on a trustworthy supply of coal. Did we need a war to teach us such things as these? Yet really at present we know of little else that has been brought out.

### AMERICAN IRON AND STEEL.

OFFICIAL statistics which have reached this side since our last issue afford in a concise manner, well worthy of being placed on record, an indication of the iron and steel-producing capacity of the United States. Such information is of especial value just now to iron and steel masters of our own country, whose attention has necessarily been a good deal occupied by the continued entrance of transatlantic material into European markets. These latest figures show that the United States possess at the present time 420 blast furnaces, with an annual producing capacity of 19,081,587 tons. Putting aside a number of furnaces that in all probability will never be operated again, the actual capacity of the completed furnaces in that country is about 18,000,000 tons per year. Of these 420 furnaces 79 use charcoal, and 341 use anthracite and bituminous coal and coke. The rolling mills show a similar increase. There are 504 completed rolling mills and steel works, with an annual capacity of 17,929,850 gross tons, omitting all forged products. This is a gain of over 21 per cent. since 1896. The total number of completed Bessemer steel works is 45. This compares with 50 two years ago, but the machinery is much more powerful. In fact, the annual converting capacity of the 45 plants now in existence is 10,633,000 gross tons, which is nearly 11 per cent. ahead of the capacity of two years ago, although there were then five more works on the list. There are now 99 completed open-hearth steel plants, with 286 furnaces, against 88 plants with 245 furnaces in 1896. There are 66 structural mills in that country, 230 completed plate sheet and skelp mills, and 69 tin-plate works. A further indication of transatlantic progress is afforded by the announcement of the floating of the Alabama Steel and Shipbuilding Company, with a capital of 490,000 dols., and with authority to issue bonds to the extent of 1,100,000 dols. This company intends to build a million-dollar steel plant at Endsley. The new undertaking is said to be promoted by the Tennessee Coal, Iron, and Railroad Company, which claims to have itself sold fully 150,000 tons of basic pig iron in England, Germany, Italy, and Russia. The new company will, it is said, afford employment for 7000 workpeople. After making the customary deductions for transatlantic "enthusiasm," it is evident that an organisation of no ordinary size is contemplated, and as its chief production will be basic steel, that will considerably help forward the basic open-hearth steel position of America, which relatively to the Bessemer position is admittedly weak.

### THE POWER OF THE PIT LAD.

IN political life we hear sometimes of "the tail wagging the head." There is no more signal example of the lesser moving the greater than is now being furnished in the coal-field of South Yorkshire. For several weeks past various collieries have had their output altogether stopped by the action of pit lads who have behaved with a boyish exuberance not so remarkable in itself as in the results it achieves. For example, the men and the boys turn up on the pit head at their appointed time. The men are ready to go down to their work in the ordinary way, when suddenly the boys refuse to follow. They have given no previous intimation whatever of having any intention that way, and for the first time the owners of the pit get the news that the lads are discontented with their wages. Their way of asking for an advance is simply to stop work there and then without notice of any kind. The issue, of course, is that, as the pit cannot be worked without the lads, all operations are suspended. Thus the boys by their abrupt action prevent the men continuing their employment, and everything in or about the pit comes to a stand because of these audacious youths. Of course, proceedings follow, and penalties are inflicted, which are supposed to represent something like the damage caused. That, of course, is purely legendary, for the Bench cannot impose upon the boys anything in the nature of fines or damages at all commensurate with the direct loss and inconvenience they bring about. The curious part of it is that the general colliery community, particularly the female portion of it, side with the lads in proceedings which, if they took place in any other industry, would inevitably bring the boys a sound thrashing. It is almost amusing to read the Yorkshire papers, and see how these lads on their way to the Police-court received an ovation quite as great as if they had achieved something noteworthy in the football or the cricket field. The lads themselves, too, were quite conscious that they were heroes, and gave themselves airs in consequence. One day over a hundred of them, instead of being awed by the magistrates, boldly asked that they might be "sent down the line"—that is, to prison—in a body. The magistrates, of course, could not oblige them in that way, and it is doubtful if what the law permitted the justices to do will at all act as an efficient deterrent in future.

### ELECTRIC LOCOMOTIVES IN FRANCE.

THE Municipal Council of Paris having stipulated that electrical power is to be used on all the underground lines in the city, the Compagnie d'Orléans has just submitted to the Minister of Public Works its scheme for employing electric locomotives on the extension from the present terminus to the new station on the Quay d'Orsay, which will be completed by the time of the Exhibition of 1900. Locomotives weighing 45 tons, and exerting a power of 700-horses, will receive the current by contact between the rails. The engines will be built on four axles, each one carryng a motor of 125 kilowatts, and they will be able to draw under normal conditions a train of 250 tons at a speed of 50 kilomètres an hour. A power-generating plant will be established at the Ivry Station. It will comprise two groups, each having a power of 1000 kilowatts. The distribution will be made by triphase currents at a tension of 5500 volts; this alternate current at high tension will be converted at two sub-stations into continuous currents at 550 volts for the motive power and 450 volts for the lighting. A line has for some time past been fitted up by the Société de Traction Electrique at St. Germain for running locomotives experimentally upon this system; but as owing to want of capital, the company has had to be reconstructed, we believe that the experiments have either been abandoned or postponed until the concern is in a position to resume them. It will be remembered that some time ago the company ran a Heilmann electric locomotive, on which the power is

generated by Willans and Robinson steam engines on the locomotive itself, on the line of the Compagnie de l'Ouest, but as the weight of these Heilmann engines would necessitate the reconstruction of most of the bridges the railway company did not deem it desirable to go to this expense.

### MINTING IN CHINA.

ABOUT a year and a-half ago the Mint (Limited), Birmingham, sent out to China a complete plant for the establishment of a mint at Nankin. The machinery, which was made in Birmingham, was of sufficient capacity to strike per day a hundred thousand silver coins, and a million brass "cash." Workmen were sent out from Birmingham both to erect the machinery and to assist in starting the mint. They have now returned to Birmingham, and Mr. Ralph Heaton, manager and director of the Birmingham Mint, has received on behalf of his firm, a glowing testimonial from Lun-yu-Sang, the head of the Imperial Mint in Nankin, as to the manner in which the work has been carried out, together with a handsome engraved gold badge. The inscription upon the badge has been translated as follows:—"Unrivalled ability in constructing mints; skill unsurpassed East or West." Although it would have been more profitable to Birmingham to do the whole of the minting for China, as in former days, it is satisfactory to find that the numerous Governments which are establishing their own mints still have to come to Birmingham for their machinery. It may be remembered that in 1877 Messrs. Heaton sent out the appliances and equipped the mint at Canton, the first established in China.

## LITERATURE.

*The Municipal and Sanitary Engineer's Hand-book.* By H. PERCY BOULNOIS, M.Inst.C.E. Third edition. London: E. and F. N. Spon, Limited. 1898.

THIS book was originally published in 1883, and was followed by a second edition in 1892. It is a work of considerable value to the town surveyor, and the present edition has been brought up to date both as regards recent legislation and modern improvements in municipal work. The author having occupied the position of City Surveyor of Exeter, Borough Engineer of Portsmouth, and City Engineer of Liverpool, has had a large and varied experience, and the result of this experience, with much valuable information collected from other sources during his long connection with town work, is given in the volume. The method adopted is good, inasmuch as only the necessary points are touched upon, and the book is not, as are so many professional hand-books, burdened with a mass of irrelevant matter. The object of the work is not so much to deal with engineering details as with the legal aspect of the many duties which at the present time devolve upon the town surveyor, and with the routine necessary to carry them out; for this purpose the author divides the volume into chapters, each being an outline treatise on the particular subject to which it refers, the elaboration of which and its practical application must be left to the reader, but in most cases he gives the sources from which further particulars may be obtained.

A large portion of the book consists of extracts from, and references to, the numerous Acts of Parliament under which the municipal engineer has to work, and much useful information is given as to the best method of putting them into force, including forms of resolutions to be passed by local authorities, and notices to be served in order to comply with the requirements of the different statutes. The legal portions of the volume have been scrutinised and revised by Mr. J. B. Regnier Conder.

As borough engineers are usually chosen from the ranks of assistants in large towns where departmentalism must of necessity prevail, it is scarcely possible for any one man to have had actual experience in all of the many branches of municipal work; this book, therefore, will be found invaluable, and will save hours of weary searching of Acts of Parliament and precedents of procedure.

The town surveyor of to-day must be a competent engineer, and have a considerable knowledge of architecture, law, and chemistry; he must also understand finance, so as to be able to advise his authority on the financial aspect of any scheme which may be under consideration.

An excellent table of duties is given in the third chapter, from which the following list is extracted:—Engineering: Bridges, sewerage, sewage disposal, water, road making, prevention of floods, tramways, and street lighting. Architecture: Building, surveyor's duties, and the design and maintenance of corporation buildings, including offices, police and fire stations, artisans' dwellings, baths, mortuaries, markets, and abattoirs. Law: Sanitary, gas, and water Acts; electric light and tramway orders, parliamentary work, arbitrations, and contracts. Miscellaneous: Scavenging, road watering, hygiene, landscape gardening, and disinfection. Surveying: Field work, quantities, and valuations. Administration: Wages, tradesmen's accounts, and reports and statistics for committees.

Under each heading the author states concisely the considerations which should guide the engineer in designing and carrying out works, or performing other duties, with suggestions as to the best methods to be employed.

The chapters relating to the construction and maintenance of roads and footpaths are of special value, as the subject is scientifically and exhaustively treated; the question of street traffic is dealt with and the method of reducing it to a common standard explained, and tables showing the tractive force required to draw a load on different kinds of roads are given. The materials in general use for carriage and footways are fully described, and their advantages, disadvantages, and suitability under varying conditions discussed. Complete specifications, which should prove useful to the engineer, as to mode of construction and materials employed are also given. In addition there are tables of the cost of several pavements and their maintenance, as compared with macadam; but they are only of value as showing how to calculate the point, in any locality where economy commences with the substitution of permanent paving for macadam.

The author refers to Australian hard-wood paving, which he prefers to the softer woods so extensively used hitherto; but it is to be regretted that he has not touched upon its disadvantages, one of which has caused much anxiety, viz., the undue shrinkage of the blocks. More consideration might also have been given to the methods in vogue of grouting a close-jointed pavement, as the system described of brushing a tar mixture over the surface is not altogether satisfactory, inasmuch as the grout does not penetrate sufficiently deep in the transverse joints to render it impervious, and when the joint is somewhat open, owing to the convexity of the road, the mixture melts in hot weather, runs under the blocks, and produces an uneven surface.

The author describes a concrete slab for footways made by him in Liverpool from the residue of the dust destructor at a cost of 1s. 8d. per superficial yard, and refers to the "Proceedings" of the Association of Municipal and Sanitary Engineers for the process of manufacture. As this is a matter of great importance to the town surveyor, it would have been an advantage if the portion of the paper relating thereto could have been incorporated in this work. Considerable additions have been made in this edition to the chapter on street lighting, and comparative tables of the illuminating power and cost of lighting by means of ordinary gas burners, incandescent gas burners, and electric arc lights are given, also a table showing the proper hours for lighting and extinguishing street lamps throughout the year.

The duties required of the surveyor in connection with street naming and numbering, the breaking up of streets for laying drains, gas, and water pipes, and the proper method of dealing with obstructions in streets—under which heading are included improving frontages, removing projections, doors and gates opening outwards, vault and cellar coverings, water flowing over footpaths, sun blinds and awnings, overhanging trees, hoardings and dangerous buildings and places—are not strictly engineering matters, but are questions which cause much trouble, and the author shows concisely how they are to be treated, and gives forms of notices to be served upon offenders.

The chapter on private-street improvements contains precise information as to the exact method of procedure under the Public Health Act, 1875, and the Private Streets Works Act, 1892, which will be of much service, as the least informality may nullify any proceedings under these statutes, and necessitate the whole of the work being commenced *de novo*. It would have added to the usefulness of the volume if the author had given some specimen plans and apportionments. The subject of scavenging, both with reference to street cleansing and watering, and the collection and disposal of house refuse, is discussed, and some reference made to the destruction of the latter by fire; but the consideration of all the different devices for effecting this is beyond the scope of the work. Under the heading of "New Streets and Buildings," the duties of the surveyor in connection with the enforcement of bye-laws are given. Two short chapters are devoted to sewerage and sewage disposal, which give the general principles upon which these works should be constructed and the law relating thereto. The subject is, as the author states, too large to be dealt with in this hand-book. The question of sewer ventilation is gone into at some length, and descriptions are given of various methods which have been devised from time to time with remarks as to their efficiency or otherwise.

The Housing of the Working Classes Act, 1890, is fully explained, and some useful hints are given as to points to be considered in constructing artisans' dwellings; also a table of death-rates in various industrial dwellings as compared with the general rate in the metropolis, showing that the tendency of such improved habitations is to decrease the mortality. One chapter relates to defects in dwelling-houses, &c., which are to be dealt with by the surveyor, such as cellar dwellings, insufficient water-closet accommodation, &c. On the subject of house drainagethe vexed question of sewer *versus* drain is discussed, and the author sets forth the essential requirements of good house drainage, among which he includes the syphon trap or interceptor to cut off the house drain from the sewer. This is a matter of controversy, many sanitary engineers being of opinion that such a trap is a positive evil, as it is a frequent cause of stoppage; it retards the flow in the drain, and it retains in the vicinity of the dwelling-house a considerable quantity of sewage, the decomposition of which produces sewer gas on the premises, and delivers it into the sewer in a putrid state. The syphon trap also interferes with the thorough ventilation of the sewerage system. At a recent conference of metropolitan surveyors it was considered desirable that all branch drains should be ventilated by means of upcast shafts fixed to the houses; this, however, would be obviated by the abolition of the trap, as the soil pipes would answer the purpose, and no harm could arise where the drain is made water-tight, as now required in London, the closet-pan properly trapped and anti-syphoned if necessary, and all waste pipes trapped and made to discharge over gullies. In this chapter there is a set of model regulations as to the construction of the portion of a house drain under the street.

Valuable suggestions are given as to laying out recreation grounds and cemeteries, planting trees in streets, the construction of public abattoirs, markets, mortuaries, and conveniences. As most permanent works are too costly to be paid for out of current rates, and money has to be borrowed with the sanction of the Local Government Board, the author devotes a chapter to the method of getting their consent, and gives the approximate time, varying from five to fifty years, over which the Board will allow the repayments to extend for different works. The book concludes with a chapter on contracts,

*Hydraulic and Placer Mining.* By EUGENE B. WILSON. New York: John Wiley and Son. London: Chapman and Hall, Limited. 1898. 12mo. Vol. vi., and 234 pages, cloth. 2 dols.

THIS work provides various imperfect accounts of the application of water in mining operations, for the author extends the term hydraulic mining much beyond its usually accepted signification; not that this matters much, since, judging from the work before us, and other volumes produced by a writer of the same name as the author, any views expressed cannot be regarded as carrying any great weight; but, anyway, it is perhaps worth mentioning in this case, as it seems to be the only feature approaching originality in the volume, except, perhaps, some extraordinary productions provided by way of illustrations. The volume, however, deals with the application of water in mines, prospecting placers, collecting gold in sluices, the conveyance of water, jet hydraulic mining, gravel elevators, river dredgers, diggers, and mining regulations of the United States and Canadian Yukon. Then, there are various tables, and an index.

The matter, in the main, has been most ably dealt with in existing works; and, taken altogether, if any use at all can be suggested for this volume, it would seem to be that it is admirably adapted to suit the requirements of those in search of a superficial and fragmentary knowledge of the subjects enumerated.

### SHORT NOTICES.

*Hydrographical Surveying: A Description of the Means and Methods Employed in Constructing Marine Charts.* By Rear-Admiral Sir William J. L. Wharton, Hydrographer to the Admiralty, K.C.B. Second and revised edition. London: John Murray. 1898. Price 18s.—Sir William Wharton's book is so well known that a notice of any length of this new edition is unnecessary. It is sufficient to say that the book is brought fully up to date in those matters which have undergone change since 1882, when the first edition was published. The subject of deep-sea sounding, in which there has been an entire revolution, is dealt with by Captain A. M. Field, R.N., and Captain W. U. Moore, R.N., who are responsible for that section The book is worthy of the high reputation of its author as our Admiralty Hydrographer.

*Electrical Engineers' Central Station Directory: Containing Information about Various Central Stations in Operation and Contemplation, &c. &c.* London: Biggs and Son. Price 3s. 6d.—This is a very useful book. Its title does not convey an adequate idea of the great amount of information it contains—information, too, the greater part of which must have been obtained with considerable difficulty. We have checked over some of the figures and statements, and find them perfectly correct, so that no doubt the book, as a whole, is trustworthy. We can heartily recommend it, not to engineers only, but municipal authorities in general.

*Lean's Royal Navy List: Containing Special Points of Interest; War and Meritorious Services, &c., Famous Battleships, &c. &c.* No. 83, July, 1898. By Lieut.-Colonel Francis Lean (retired full pay), R.M.L.I. London: Witherby and Co. Published quarterly, price 7s. 6d.—This is the eighty-third number of this publication. The twenty years' experience of its editor has resulted in the production of a very complete and accurate guide. The present number appears to be brought close up to date.

### *BOOKS RECEIVED.*

*Cassier's Magazine.* July, 1898. London: 33, Bedford-street. Price 1s.

*Transactions of the American Institute of Electrical Engineers.* April, 1898. New York City: 36, Cortlandt-street.

*Publications of the Smithsonian Institution.* Available for distribution April, 1898. City of Washington, April, 1898.

*Problems of Modern Industry.* By Sidney and Beatrice Webb. London: Longmans, Green, and Co. 1898. Price 7s. 6d.

*Electricity in Town and Country Houses.* By Percy E. Scrutton. Westminster, London: Archibald Constable and Co. 1898. Price 2s. 6d.

*Régularisation du Mouvement dans les Machines.* Par L. Lecornu. Paris: Gauthier-Villars et Fils, and Masson et Cie. Price 2·50f. and 3f.

*The Doctrine of Energy: A Theory of Reality.* By B. L. L. London: Kegan Paul, Trench, Trübner, and Co., Limited. 1898. Price 2s. 6d. net.

*Financial Sketches.* By Hélène Gingold and Dudley Hardy, R.I. London: The Colombus Printing, Publishing, and Advertising Company, Limited. Price 1s. net.

*Nouveau Traité des Bicycles and Bicyclettes: Le Travail.* Par C. Bourlet. Deuxième edition. Paris: Gauthier-Villars et Fils, Masson et Cie. Price 2·50f. and 3f.

*The Journal of the Royal Agricultural Society of England.* Third series. Vol. ix. Part II. No. 34, 30th June, 1898. To be continued quarterly. London: John Murray. Price 3s. 6d.

*Lighting by Acetylene: Generators, Burners, and Electric Furnaces.* By Wm. E. Gibbs, M.E. New York: D. Van Nostrand Company. London: Crosby Lockwood and Son. 1898. Price 7s. 6d.

*Iron and Steel Bridges and Viaducts: A Practical Treatise upon their Construction for the Use of Engineers, Draughtsmen, and Students.* By Francis Campin, C.E. With numerous illustrations. London: Crosby Lockwood and Son. 1898. Price 3s. 6d.

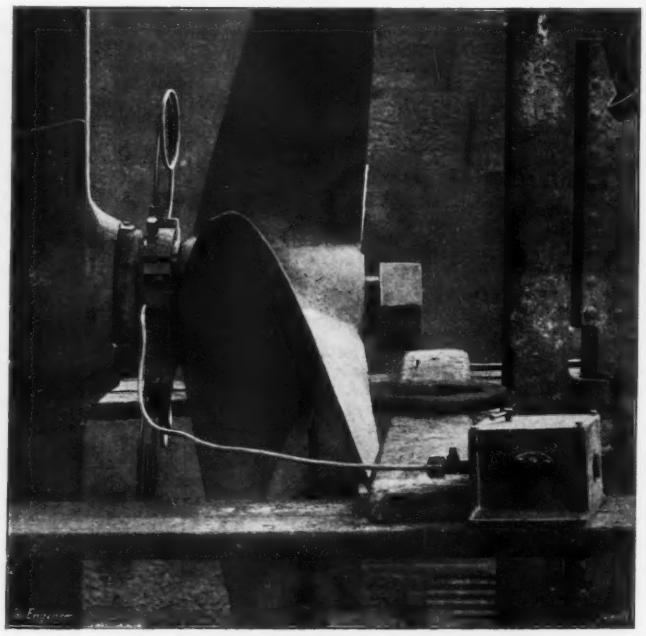
*A Handbook to the Workmen's Compensation Act, 1897, with the full Text of the Act, the Regulations as to Medical Referees, and the Workmen's Compensation Rules, 1898.* By R. M. Minton-Senhouse and G. F. Emery, LL.M. London and Derby: Bemrose and Sons, Limited. Price 1s. net.

ASSOCIATION OF OLD STUDENTS OF THE CENTRAL TECHNICAL COLLEGE, S.W.—On Thursday, 7th inst., the first annual dinner of this Association took place at the Holborn Restaurant. The chair was occupied by the President, Professor Ayrton, F.R.S., and among those present were Professor Armstrong, F.R.S., Professor Henrici, F.R.S., Professor Kipping, F.R.S., and a number of other gentlemen well known in the technical world. The chairman, in a very humorous speech, proposing the toast of "The Association," observed that rarely had he seen so many students so earnestly engaged in physical investigations into the properties of materials, and the behaviour of fluids, "more or less perfect," than upon that occasion. He objected to the phrase "Professors and Old Students," contending that the professors being both "old" and "students," it was quite unnecessary to draw a distinction. The toast was responded to by Mr. G. A. Burls, secretary of the Association. The very satisfactory condition, both as to membership and finance, were pointed out; other toasts were "The College," proposed by Mr. Ackerman and responded to by Professor Henrici; "The Professors," proposed by Mr. R. L. Jenks, received with musical honours, and responded to by Professor Armstrong; and "The Chairman," proposed by Mr. F. F. Renwick, and duly honoured. Songs and recitations were given by Messrs. Bayly, Seligman, and others, and an extremely pleasant evening was spent by the sixty gentlemen forming the company. The Association is to be congratulated upon the great success of its first dinner, and upon its very flourishing condition. Old Students of the College desiring to join the Association are requested to apply to the permanent secretary at the College.

## HYDRAULIC PROPELLER STARTER.

EVERY superintendent engineer is familiar with the troubles encountered when a tail shaft has to be drawn in removing the propeller. If the operation has not been carried out for a considerable period, the propeller will usually be found set fast on the cone of the tail shaft, owing to that curious process of cold welding which seems to be set up between two iron surfaces when they are kept in forced contact for a considerable period, and at the same time exposed to vibration or shock. To get the propeller off is frequently a matter of great difficulty, causing long delay. Fires have to be lighted round the boss, dollies slung to strike the propeller, and so on. In all cases wedges have to be employed.

The hydraulic starter which we illustrate, patented by Messrs. Young, Ryland-street Works, Birmingham, appears to get over the difficulty in a very simple and straightforward way. The accompanying illustrations almost explain themselves. The starter consists of four segments B, which can be bolted up round the shaft as shown. Each segment contains a curved ram A, leather packed, as shown in the section. The ram cases are all coupled up by curved upper pipes. Water is forced in through the pipe C and drives out the rams, and of course forces off the propeller. The starter can exert a stress of 300 tons; that is to say, 75 tons for each ram. The method of using it will be understood at once from the perspective view from a photograph taken in a dock at Cardiff last March. The ship in question was the Jane Radcliffe. The maximum force exerted was 214 tons. The whole apparatus, including the pump, weighs 5¼ cwt.

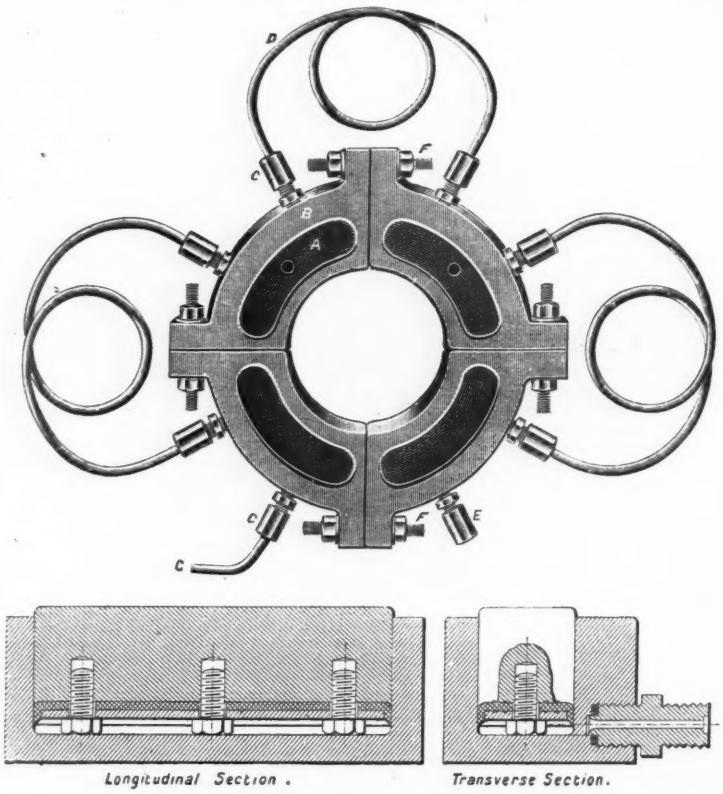


HYDRAULIC PROPELLER STARTER

## VENTILATING ENGINES, GARSWOOD HALL COLLIERIES.

THE illustration on page 60 represents a pair of horizontal engines which form part of an installation of ventilating machinery erected at the collieries of the Garswood Hall Collieries Co., Brynn, near Wigan. This machinery was supplied by Messrs. Walker Brothers, of Pagefield Ironworks, Wigan. The installation is unique in its character, inasmuch as it is probably the most powerful of its kind in the United Kingdom, if not in any mining district in the world; the ventilating capacity of the fan and engines being 500,000 cubic feet of air per minute, with 6in. water gauge. The engines are of the twin, or side-by-side, compound type, with a high-pressure cylinder 26in. diameter, and a low-pressure cylinder 48in. diameter by 5ft. stroke. The steam pressure is 100 lb. per square inch. The valves of the cylinders are of the simple slide type, with the addition of Meyer's expansion valves—variable by hand whilst the engines are at work—not only to the high-pressure cylinder, but the low-pressure cylinder also, as the gradually increasing demands upon the ventilating machinery necessitate an alteration of the cut-off from time to time in both steam cylinders, as it is desirable that the power derived from each of the engines should be as far as is possible equal to that of the other.

Whilst engines with valves of the Corliss and other types of valve gearing are extensively manufactured by this firm, still in the case of fan engines slide valves are preferred on account of their simplicity. In ventilating machinery for collieries, which has to run continuously night and day all the year round, with the exception of perhaps a few hours' stoppage on Sunday mornings—and this not in all cases—it is imperative to have the valve and other gearing as simple as possible, consistently with economical steam consumption, and with the minimum liability to derangement and break down. For these reasons Messrs. Walker prefer valves on the slide principle for fan engines. The steam and exhaust pipes are so arranged that the engines can work either as a pair or separately, all that is necessary to effect this being the opening or closing of one or two valves and the removal of the connecting-rod. In the case of the low-pressure engine, if this be required to work alone, then the steam has to pass through a reducing valve, which is provided with a safety valve to prevent the possibility of the steam entering the low-pressure cylinder at the full boiler pressure. The rope pulley fly-wheel is 24ft. in diameter, about 28 tons in weight, and is grooved for eighteen ropes, 1¾in. diameter. The condensing apparatus is the vertical jet type. The air pump is worked from a trail shaft connected by means of a drag link with the crank pin on the low-pressure side. This condenser is not only connected with the low-pressure cylinder as in the ordinary conditions of working, but when the high-pressure engine is required to work alone it condenses the steam from this engine also.




HYDRAULIC PROPELLER STARTER

The ventilating fan is of the Walker "Indestructible" type, the design of which is the outcome of the nearly thirty years' experience which this firm has had in the construction of colliery ventilating machinery, during which time, we understand, they have supplied fans having an aggregate exhausting capacity of about forty millions cubic feet of air per minute. As already stated the duty required from the installation of ventilating machinery we are now describing is 500,000 cubic feet of air per minute with a water gauge of 6in. This machinery has, however, a margin of power beyond this. The fan is 30ft. in diameter, and 9ft. wide across the vanes. The pulley upon the fan shaft is 11ft. diameter, and grooved, as in the case of the fly-wheel drum, for eighteen ropes 1¾in. diameter.

It may be stated that Messrs. Walker construct fans for moderate duties directly driven by the engines, without rope or belt gearing, but their experience for the larger and heavier duties now required at collieries has convinced them that for permanent economy in fuel, lubrication, wear and tear; and freedom from breakdowns, the application of rope gearing is the best mode of driving fans.

Moderate velocities of engines and fans they regard as essential for safe and economical working; but under ordinary circumstances, and, indeed, for the heaviest duties, the fan may be made to run with equal safety at two and a-half to three times the velocity of the engines, the comparison being made between the fan shaft and the crank shaft as to the number of revolutions per minute. The fan is called "Indestructible" by Messrs. Walker, owing to its strength. Their experience has taught them that freedom from stoppage for repairs in the working of colliery ventilating machinery is the chief object to be attained. Economy in steam consumption and general wear and tear rank almost equally high. In former years these points were regarded as of less consideration. Now the indicator diagrams are criticised as on board ship. It must be remembered, however, that the fuel consumed for steam purposes at collieries ordinarily is refuse, and that which usually is not put on the market.

Notwithstanding this, the rule rather than the exception at English collieries now is to have engines of the highest class, compound and condensing, with steam boilers of equal quality. Hence the slur which was formerly cast on colliery owners of "wasting the national fuel resources" has lost its foundation in fact. The conditions of coal consumption at collieries have completely changed from what they were formerly; and no class of steam users display more keenness as to economy in this respect than British colliery owners do at the present time. The ventilating machinery here illustrated was designed and constructed to the order of the Garswood Hall Collieries Company in this spirit, and with a chief regard to endurance and permanent economy in working. Considering that a colliery fan runs 365 days and nights in the year, too great attention to perfecting engines and fans in general design and detail can scarcely be exercised by the engineer; and any extra first cost incurred in laying down machinery of the highest class is quickly recouped by the greater economy in working.

## DOCKYARD NOTES.

THE Gromet torpedo nets and the gyroscope-fitted torpedoes being now supplied to the Channel Fleet, the present cruise is likely to be more or less a torpedo one. The Gromet net has a mesh about one-third the diameter of the old pattern nets, and the rings are a trifle stouter. In the old nets the rings were in parallel lines, loosely joined by four medium rings—one at top, one at bottom, and one on either side. In the new net the rings run diagonally, and the joining rings are smaller and stouter. A net-cutting machine cannot, therefore, encounter a single wire, and in all the experiments with the Hannibal the cutter signally failed.

The gyroscope attachment to torpedoes is of a strictly confidential nature. Opinions as to its merits are not unanimous, although, as a rule, highly favourable. The invention may, perhaps, best be likened to the invention of rifling for guns. The assertion that certainty in hitting is now secured is, however, somewhat premature. It provides against deflection by tides and currents, and to that extent assists aim. The great thing that it does, or should do, is to increase the range of torpedoes. It will in future be reasonable to attempt to hit the target at 800 yards. It would not be wise to assert much more than that for it; the gun still holds the field as the weapon *par excellence*, and is likely long to do so.

THE Japanese 24in. torpedo has evoked some comment of late. This weapon has also a gyroscope controller, and is supposed to travel 1000 yards without appreciable loss of speed. Such weapons are likely to increase and complicate the science of naval tactics, to make the range of future actions still greater, and thus indirectly put a premium on good gunnery.

THE French battleship Amiral Baudin has emerged from her reconstruction much altered. A new and high funnel has been placed, the after-military mast removed, and the top reduced upon the fore mast. The structural alterations have already been referred to.

A CORRESPONDENT signing himself "Foreigner" took exception last week to the comparison in these notes between the Elswick-built Harald Haarfagre and the Marechal Deodoro. If "Foreigner" saw the meeting of the English and French squadrons in the Channel when the Czar was escorted over, he would understand the speed failing of French ships.

French designs have many good points, but, so far, to maintain speed in a seaway has been beyond them. In the desire to obtain a lofty gun platform, the steadiness of that platform has been lost sight of. Speaking generally, French ships are tremendous rollers, in consequence of their top hamper, and rolling is not beneficial to speed at sea.

With regard to the two ships, "Foreigner's" contention is a little hard to follow. The Harald Haarfagre we know well, and in her the maximum safe offensive and defensive powers for her displacement are realised. Yet, on paper, the Deodoro, of less displacement, is a better ship; consequently we cannot reconcile ourselves to the figures as given, save on the assumption that the French ship will be "crank" perhaps in this connection.

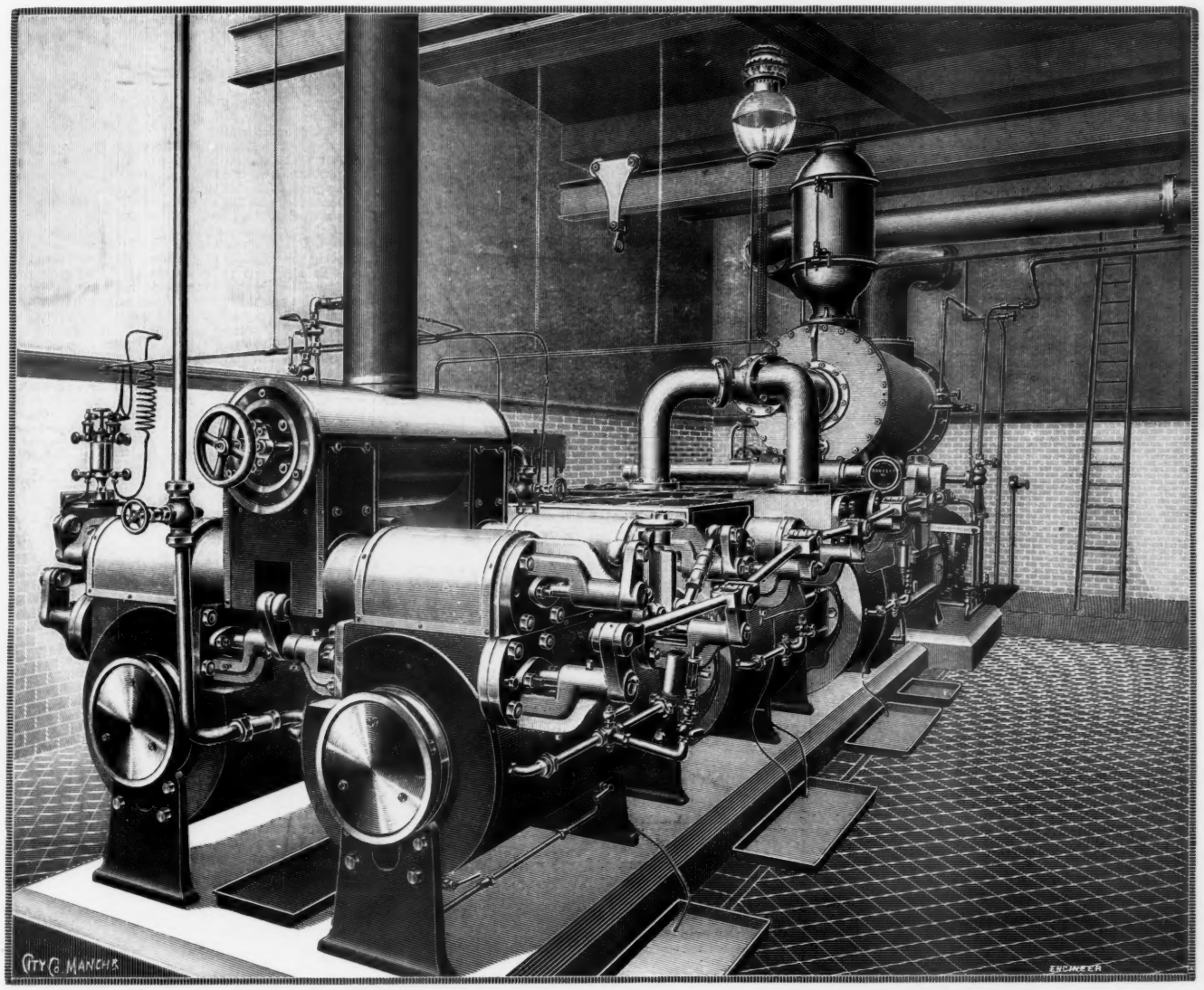
We may point out that at Yalu the Japanese had the three Matsushimas of La Seyne design, Yoshino from Elswick, Chiyoda from Clydebank, Fusoo from the Thames. Their subsequent orders have not gone to La Seyne.

THE destroyer Thrasher has now been patched up and repaired, but the damage to her machinery consequent upon the penetration of her sides and bottom is said to have been sufficiently serious to prevent her ever again reaching her proper speed. If this be so, the reason for her repairs or retention are not very obvious. Probably the wisest thing to do after she crashed upon the Deadman would have been to break her up.

IT is officially announced that, as the result of the Imperial conference on postal rates, it has been agreed, on the proposal of the representative of the Dominion of Canada, that letter postage of one penny per half-ounce should be established between the United Kingdom, Canada, Newfoundland, the Cape Colony, Natal, and such of the Crown Colonies as may, after communication with and approval of her Majesty's Government, be willing to adopt it. The date on which the reduction will come into effect will be announced later on. The question of a uniform reduced rate for the whole Empire was carefully considered; but it was not found possible to fix upon a rate acceptable to all the Governments concerned. A resolution was therefore adopted, leaving it to those parts of the Empire which were prepared for penny postage to make necessary arrangements among themselves.

# PUMPING ENGINES AT IPSWICH WATERWORKS

MESSRS. SIMPSON AND CO., LONDON, ENGINEERS




## IPSWICH WATERWORKS.

SOME years ago, when the Corporation of Ipswich took over from a private company the works for supplying water to that town, one of the first steps taken to ensure an efficient supply was to increase the pumping plant, so that in case of breakdown of one unit the constant service could be kept up. The engine then in use was of the old Cornish type. This was supplemented by a Worthington engine, made by Messrs. Simpson and Co., Pimlico, London, S.W., which has continued to give highly satisfactory results. Accordingly, upon the recent breakdown of the Cornish engine, the Corporation, acting upon the recommendation of their engineer, Mr. Hamlet Roberts, decided to replace it by an engine which, while embodying the slight modifications suggested by this gentleman as a result of his experience, should be practically a duplicate of that already in use. We are enabled to give an engraving of this engine herewith. It is of the triple-expánsion type, and was designed to pump 2,000,000 gallons in twenty-four hours, working with a steam pressure of 120 lb. per square inch. As will be seen, it is horizontal, the cylinders being arranged in line with the pump plungers, thereby transmitting their effort without the intervention of any gear or connection. The leading dimensions are as follows:—High-pressure cylinders, 9½in. diameter; intermediate, 14in.; low-pressure, 24in.; with a stroke of 28in. Each cylinder is steam jacketed, and both cylinders and equilibrium passages are lagged with sheet steel. The steam valves on all the cylinders are of the Corliss type, and are arranged on the top; the cut-off valves fitted to the high-pressure cylinders are variable by hand, and may be adjusted while the engine is running to cut off at any point of the stroke by hand wheels placed in a convenient position. The cylinders are rigidly connected to one another, and to the pump by massive frames, which keep the whole in line and quite independent of the foundations. The pump is double-acting on both the suction and delivery sides, and consists of two chambers divided by a diaphragm. Each chamber is fitted with a number of small multiple spring-loaded valves, these are india-rubber, falling on gun-metal grid seats, and are accessible by suitable doors for purposes of examination. The surface condenser is arranged on the top of the pump forming the delivery chamber, and consists of a number of brass tubes secured into the end plates by stuffing-boxes with packings set up with screwed ferrules. The delivery water passes around the outside of the tubes and the exhaust steam inside on its way to the air pump. The air pump is located behind the main pump, and is driven by an extension of the pump rod direct, and although of the horizontal type, a vacuum of nearly 29in. was maintained on the day of our inspection of the engines. The valves are similar to those of the main pump, adapted to suit the altered condition under which they have to work.

Steam is supplied to this engine by a Lancashire boiler, at the back of which and in the main flue is a Schwoerer superheater, the pipes of which form part of the main steam connection, so that the whole of the steam generated by the boiler passes through it. The hot gases on their way to the chimney circulate on the outside, so that by the time the steam reaches the engine a superheat of about 100 deg. Fah. is obtained.

## A PAIR OF OLD STEAM ENGINES.

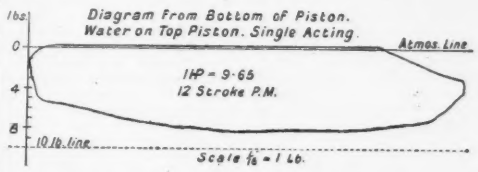
ON page 57 we illustrate two very old engines which possess no small interest. The first is in existence at Caprington Colliery. We are indebted to Mr. Bryan Donkin for the following memoir concerning it:—

"Probably one of the best examples of historical engines is the Earlston, an old Newcomen pumping engine still occasionally worked at the Caprington Colliery, two miles from Kilmarnock near Glasgow. The history of this engine is uneventful. It was set up at Caprington in 1806, and has been used almost continuously ever since, at the same place, practically without any renewals or alterations. The grandfather of Mr. Hugh Dunn, the present manager of the colliery, was in charge of the works in 1806, and the engine has therefore been, so to speak, uninterruptedly in the hands of one family. Some time ago it was proposed to remove it, but as it was found still serviceable, giving little trouble, and capable of useful work on an emergency, it was left in position. On one occasion, when the workings in the mine were flooded to a depth of 30ft., it was set to work, night and day, and pumped out the water in six weeks.

"The engine, with the boiler beneath it, stands in an isolated house, with half of the beam projecting, as shown in the engraving. It is single-acting single-cylinder, and the piston descends by the vacuum formed below it. The diameter of the cylinder is 30in.; stroke, 5ft. 3in.; diameter of the pump, 9in.; stroke, 5ft. 3in., or the same as that of the motor piston, as the beam is of equal length on either side of the main bearings. The jackhead and service pumps are both 5⅞in. diameter and 2ft. 7½in. stroke. The lift of the main pump is 170ft., and both engine and pump work at twelve strokes per minute. The steam pressure in the boiler is about ½ lb. above atmosphere, vacuum in the cylinder from diagrams recently taken 8½ lb. The engine indicates 9·65-horse power, and the pump 8·32-horse power. Mean unbalanced pressure under the piston 7·16lb., due to the vacuum from the condensation of the steam.

"The only structural change made in the engine since it was first set up was the substitution, about fifty years ago, of a cast iron beam with radius bar and parallel motion for the original old wooden beam with "cradles" at either end. The engine has, however, worn out several boilers since first started. The top of the cylinder is open, and to prevent the passing of air below the piston, a jet of water from the pump plays constantly above the piston. If too much water accumulates, it is led off through a hole and pipe, at a suitable level, to the hot well.

"I have fortunately succeeded in obtaining a photograph and indicator diagrams from this fine old engine. This valve gear is of the type usual in these old Newcomen engines, with tappet-rods worked from the beam, tappet levers and catches; one tappet arrangement is for the injection water, and another for the steam inlet. The view is from a photograph taken from a distance by one of the draughtsmen of Mr. Kennedy, sen., of the Glenfield Colliery, Kilmarnock, who has kindly given every assistance in his power. An indicator cock was fixed on the engine by Mr. Hugh Dunn, the manager, in October, 1897, and the interesting indicator diagram here shown was kindly taken for me by Mr. Robert




Kennedy while the engine was going at twelve strokes per minute. All the above particulars and photograph were courteously furnished to me by Messrs. Kennedy—father and son—and Mr. Dunn."

For the photograph of the second engine we are indebted to Messrs. Avery, who, it will be remembered, acquired the celebrated Soho Works of Messrs. Boulton and Watt a few years ago, and carry on the business under the title of Messrs. James Watt and Co. It is said that this is the oldest Watt engine in the world. It is in the possession of the Birmingham Canal Navigations, and was constructed by Messrs. Boulton and Watt in the year 1777, the order being entered in the firm's books in that year as a single-acting beam engine, with chains at each end of a wood beam, and having the steam cylinder 32in. diameter, with a stroke of 8ft., and erected at a canal company's pumping station at Rolfe-street, Smethwick.

During the present year—1898—this remarkable old engine, which has been regularly at work from the time of its erection to the current year, a period of, say, 120 years, was removed to the canal company's station at Ocker Hill, Tipton, there to be re-erected and preserved as a relic of what can be done by good management when dealing with machinery of undoubted quality.

It is worthy of note that the Birmingham Canal Navigations favoured Messrs. Boulton and Watt in 1777 with the order for this engine, and in 1898, or 120 years afterwards, the company has entrusted the same firm, Messrs. James Watt and Co., Soho, Smethwick, with the manufacture of two of their modern triple-expansion vertical engines, to be erected at the Walsall Pumping Station, having 240-horse power, and a pumping capacity of 12,713,600 gallons per day.

## LETTERS TO THE EDITOR.

*(We do not hold ourselves responsible for the opinions of our correspondents.)*

### TRAIN RESISTANCE.

SIR,—In dealing with the above subject in your issue of 11th March, 1898, you make what appears to me an astonishing statement, viz., that you believe it is impossible to get fatter diagrams from a locomotive as the speed increases. Now, however convincing such a statement may be to the lay reader, more especially when it is borne in mind that hitherto published results support the dictum, it is no proof that fatter diagrams cannot be obtained—as the speed rises—from properly designed locomotives.

It is equally surprising to me to find that no practical locomotive engineer has so far disputed your contention, as it must appear strange to some of them at least how it is that, with our increased boiler pressures, the modern locomotive cannot run much faster than some of the engines that were designed forty years ago did. The fact is that no improvements have been made to get the steam in and out of the cylinders fast enough, and all that has been gained by the augmented pressures is that it enables the driver to link his engine up still more. To such a critical pitch has this practice arrived, that engines are now being worked in mid-gear, a condition of affairs which, if the wear and tear credited to it are taken into consideration, must be perfectly intolerable to every practical locomotive engineer.

As a proof that improvements can be made in the design of cylinders which will tend to fatten the indicator diagram as the speed increases, and thereby prevent the wear and tear which is the concomitant of its lean congeners, I send you a set taken from a compound locomotive, the tractive effort of which has been computed on the basis of a 20 per cent. cut-off in the high-pressure cylinder. That is, as soon as one or two revolutions of the driving wheels have been made, the reversing lever—which controls the high-pressure valves only—is placed to 20 per cent. cut-off and kept there; after this the power of the engine is entirely controlled by the regulator according to the load hauled or the speed required.

In this case the load was 200 tons, and the speed required twenty-five miles per hour. Immediately after starting Diagrams A were taken, and when the train had settled down to a steady speed Diagrams B, which you will notice are leaner than A. But all that was necessary to get a fatter diagram was to increase the speed by admitting more steam into the cylinders; this was done by opening the regulator a little more and placing the lever at 30 per cent. cut-off. When the speed had settled down to what appeared a maximum for this cut-off, then Diagrams C were taken, proving, in my opinion, it *is* possible to get fatter diagrams with increase in speed where there is an improvement in design of the parts already referred to.

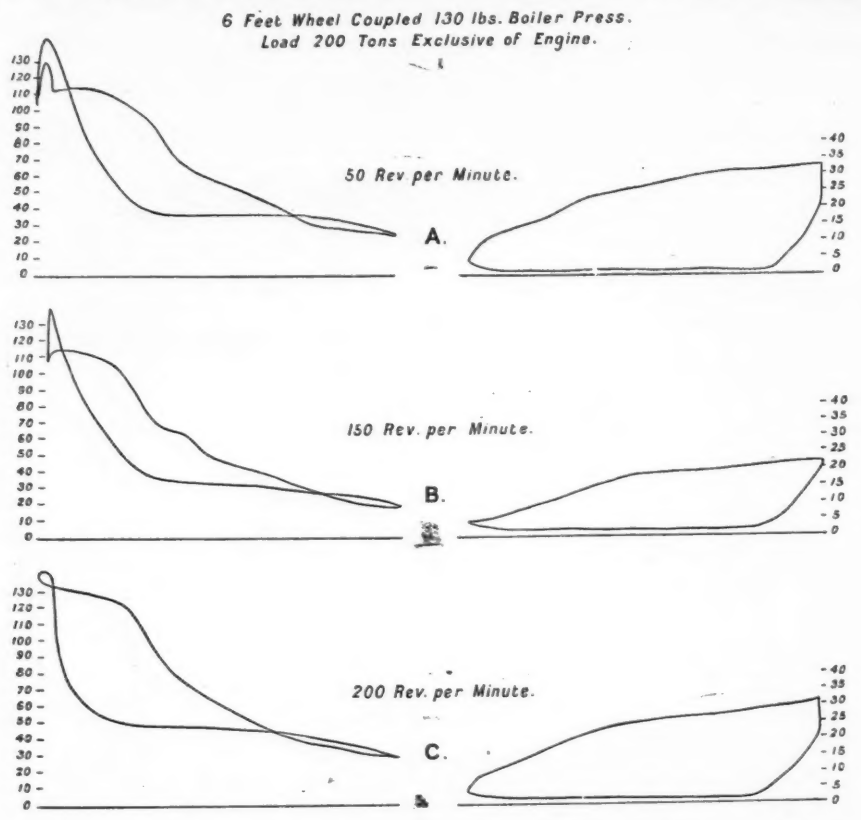
I may here mention that the low-pressure cylinder of this engine is furnished with steam ports 2½in. wide, and that they open 2in. for admission. The valve has 2½in. lap and no lead.

If locomotive engineers agree with you that they cannot make simple engines so as to give fatter diagrams, then I say, so much the worse for that type of engine, for sooner or later it is certain to literally knock itself out.

I see that four-cylinder compounds are coming into vogue again. This type of engine was tried on the North-Western Railway, in India, by Mr. Sandiford, thirteen years ago. It is true the English engines have a higher working pressure, and so may live a few years longer than the Indian one did. It must, however, be obvious that a compound engine with one large low-pressure cylinder, having two exhausts of about 5 lb. pressure, must be more economical than an engine of equal power with two small low-pressure cylinders, making four exhausts of a higher pressure.

The accompanying diagrams are not typical, and will be improved upon later.

JOHN RIEKIE,
District Locomotive Superintendent,
Sukkur, May 31st. Indian State Railways.




### AN ARCTIC EXPLORING STEAMER.

SIR,—It seems a pity that the cause of arctic navigation, in which so many of our countrymen have immortalised themselves, should be allowed to sink out of sight. With our immense wealth, and the great powers placed at our disposal by modern engineering, it is a shame to let slip the golden opportunity, and leave undone an undertaking so nearly completed by us that it wants but another effort to secure success.

A little examination of this subject will show, I think, that with suitable means the Pole may be reached. In order to make the matter perfectly clear, I will first point out the most available route. To do so, it is necessary to go back about seventy years, and take into consideration the famous voyage of Captain Parry, and draw attention once more to the too much neglected waterway which we used.

In the year 1827, on June 14th, Parry in his ship reached the latitude of 81 deg. 5 min. to the north of Spitzbergen with little difficulty in open water, with no appearance of the ice pack ahead. Yet, strange to say, he turned back in order to find a safe harbour for his vessel, to enable him to commence boat and sledge travelling over already decaying ice. After great labour and intense suffering he was compelled at length to stop and return by the condition of the ice in latitude 82 deg. 45 min., having gained but 1 deg. 40 min. in northing by sixty-one days of heroic and almost superhuman exertion. To an ordinary mind Parry's turning back with his ship with an open sea before him, when his object was to reach the Pole if possible, was a piece of simple fatuity, and to take to sledging under such circumstances and conditions showed the most extraordinary bias in favour of a predetermined method. Is it any wonder, then, that sturdy old champion of arctic navigation, Sir John Barrow, flouted the sledge method as unworthy of British seamen, and held that it ought not to have been used under the circumstances? That season was one of the most favourable and open for navigation for many years, and a splendid opportunity was lost by adopting a method of travelling totally unfit for such a condition of things. This remarkable year also showed not only the possibility but the strong probability of the truth of the claims of the old whalers having reached very high latitudes in this sea under similar conditions. Although sledge travelling upon the land and some kinds of ice may be necessary, yet it cannot perform the duties and work of a powerful and effectively equipped ship.

We now know from the experience of the last seventy years that the miles gained towards the far north in this manner has cost valuable lives, with untold labour and suffering. This to a certain extent may have been necessary owing to the relatively feeble and limited means then available, but at the present time no such reasons exist or can be rightly urged in justification of such work as that performed by Capt. Parry, for steamers can be so constructed now with ample power to overcome and break up such ice as they would be necessarily called upon to meet in the wide seas between Spitzbergen and Greenland.

As space is limited in a letter of this description, I will confine myself simply to pointing out the principal reasons for selecting this route. In the first place, it is here that marvellous current, the Gulf Stream, with its millions of tons of, comparatively speaking, warm water, enters the arctic seas, and flowing to the north and west, rises to the surface, producing the maximum of its effects in modifying the water, ice, and climate of this portion of the arctic regions. This condition extends westerly as far at least as the Parry Islands, and it is a well-known fact that to the north of them we find open water with a mild climate, when to the south Wellington Channel and Lancaster Sound are still locked up in mid-winter conditions. These mild effects are noticeable as far east as Franz Joseph Land. By entering the polar seas here a midway course is obtained, with a strong probability that considerably more open water will be found more westerly to the north of Greenland than by any other route. The impediments likely to be met with here are not of such a character as to be insurmountable by our present available powers. These favourable conditions are obtainable from about the beginning of June to the end of September, giving some sixteen weeks of daylight and fine mild weather for exploration and discovery, enabling the ship to return home for the winter, and thus avoiding those terrible hardships which heretofore accompanied such voyages. Having considered the route most likely to answer our purpose, I may now discuss what has already been done across the ocean in constructing such ice-breaking steamers as can effectively fulfil all the duties that they will be here called upon to perform.

In the United States of North America, at the Straits of Makinac, at the confluence of lakes Michigan and Huron—see THE ENGINEER, page 132, Feb 5th, 1897—the elements combine in such a manner in winter as to produce effects little short of those found in the arctic seas. Firmly-packed ice 40ft. in thickness piled up by wind and waves and solidified by 70 deg. of frost is not an uncommon occurrence, yet, strange to say, this place has been selected as a car ferry by a railway company, and notwithstanding this great impediment to navigation, its boats cut through it with ease and regularity. Based upon these facts, we may safely assume that if 40ft. of ice can be passed through in a certain manner with a given power, a greater thickness even may be penetrated in like manner with proportional means. This being granted, reduces the problem down to a matter of cost and engineering.

The great difference between these American steamers and other ice boats is that a large portion of the power is employed on the screws directly in front. These cut and break up the floes, enabling the vessels, assisted by their stern propellers, to pass through the crushed ice with little trouble or difficulty. By adopting the principle of the bow screw, with necessary modifications to meet the requirements of the case, a ship could be constructed without doubt which would be able to overcome such obstacles as would be necessarily encountered in arctic navigation.

A steamer to command such a success must have at least three principal qualifications, namely, sufficient weight, ample power, and a form with strength combined that will enable it to resist all the crushing force it will be called upon to meet. Such a boat would require a weight of at least 4000 tons, in order to ensure its water level in the ice, and a steam-power of from 5000 to 6000 horses. The hull should have a double-cellular skin, with a turtle-back deck, strongly braced with numerous bulkheads, while the engines and boilers must be so constructed and isolated that, in case of leakage, they would be completely protected from the water. The cabins and all the living accommodation should be built over the turtle-back deck. The cost of such a ship would be about one-fifth of a first-class ironclad, say, £160,000 to £180,000. Such a sum for merely scientific purposes may seem large; but when it can be shown that these vessels are useful for other duties, the amount will assume moderate proportions.

New Southgate, July 8th. RE.

### BALANCING STEAM ENGINES.

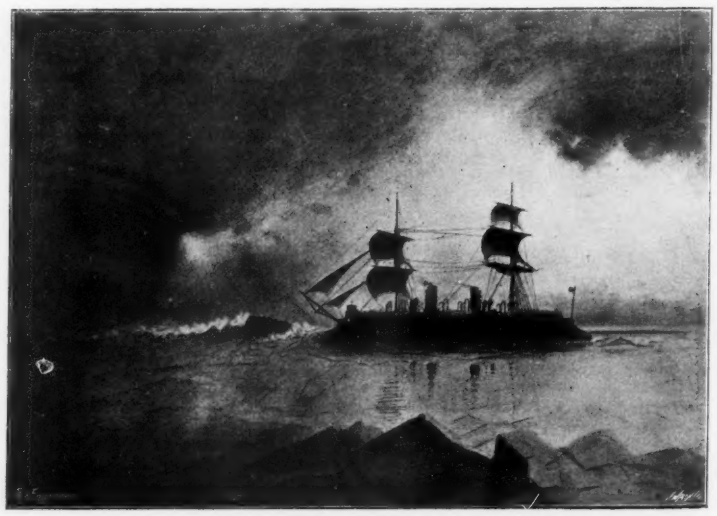
SIR,—It appears to me that Mr. Whitcher has fallen into a somewhat grave error. I have not had the advantage of reading his paper, and I am acquainted with his views only through the correspondence in THE ENGINEER. I understand him to say that the influence of the inertia and momentum of the reciprocating parts of a steam engine vary directly as the number of revolutions, other things being equal. But, as Mr. Whitcher has admitted in one of his first letters, the effect produced in this way is identical with centrifugal force, all the weights being supposed to have their centre of gravity in the crank pin. But centrifugal force varies not as the velocity, but as the square of the velocity.

It is worth notice, as bearing on this discussion, that Messrs. Yarrow, Schlick, and Tweedy, whose system has now been adopted by various leading firms in this country, attach little if any importance to the angularity of the connecting-rod. They use four cranks, but these cranks are not equally disposed round the shaft, and, as a matter of fact, the engine is not in perfect balance as regards dead weight. The position of the cranks with regard to each other is of very great importance. It is stated in an evening paper that the Terrible is having the angles of her cranks changed, with a view to reduce vibration. It is rumoured that a new Atlantic liner, not built in this country, has developed such excessive vibration that, after running one trip, she has been taken out of service for alterations of the same kind. High speed at sea can be combined with comfort for the passengers only by using precautions to prevent vibration. I am informed by an officer in the Navy that ships in which he has served are dreadfully uncomfortable, as a rule, at particular speeds, although quite satisfactory at other velocities. Our men-of-war are supposed to be too ponderous to vibrate at any speed.

London, July 11th. SUPERINTENDING ENGINEER.

### THE WATERLOO AND THE BANK RAILWAY.

SIR,—May I suggest that some censure should be passed on the Waterloo and Bank Railway Company in regard to its barbarity in making its passengers walk or climb up inclines and staircases 40 vertical feet—apparently to save the cost of elevators. I went down to the platforms at the City station a few days ago, and was horrified at the burden imposed on travellers. To young, spry persons it does not matter, but to infirm and elderly persons like myself it is appalling, especially if one carries a bag and is in a hurry. Except that the railway journey is to be only five minutes, instead of seven by the present South-Eastern route, the whole gain of the new line appears to be neutralised. Why do British architects and engineers deprive us of modern ameliorations? Some time ago I had to visit the engineer's department at the Admiralty. One could understand the uncouth arrangements at the old ramshackle buildings in Whitehall, but at the new offices in Spring-gardens it is unpardonable. I had to climb about five flights of stairs, and when I asked for the "lift," the porter only



ARCTIC EXPLORING STEAMER ENTERING THE ICE

grinned sarcastic. There was a lift for the coals; but as it was only the engineering department upstairs, and "my Lords" dwelt on the ground floor, it did not matter. Much intellect is needed to compare horizontal with vertical dimensions. Do you realise that the length of the Campania is one and a-half times the height of St. Paul's?

ONE OUT OF BREATH.

London, July 12th.

### JULY TRAIN SERVICES.

SIR,—Glancing over my article in your issue of the 8th inst., it has occurred to me that I might have included among my list of alterations possessing interest from the engineering view-point the excellent new express which has been put on by the North-Eastern line, leaving Edinburgh at 9.15 a.m. for York and Sheffield.

This train makes the run from Edinburgh to Newcastle, 124½ miles, without stop in 145 minutes, which, although slower than the corresponding down run, is, so far as I can remember, quicker than any previous timing from Edinburgh to Newcastle. Allowance has also to be made for the ascent of the Cockburnspath bank, coming south. The average speed of the run is 51·5 miles an hour. The remainder of the journey has no novel features, but the total time from Edinburgh to Sheffield is 5 hours 20 min., as compared with 5 hours 55 min., the quickest timing of last season, and also as against 6 hours 10 min., the quickest present time by any other route.

CHARLES ROUS-MARTEN.

July 13th.

### THEORETICAL DYNAMICS.

SIR,—According to your correspondent, Mr. Lousley, a body weighs as much when it is falling at a constant velocity as it does when at rest, no matter what the velocity.

Perhaps Mr. Lousley will explain why, under these circumstances, an overshot water-wheel should not have a greater velocity of run than about 6ft. per second. Again, turbines working by pressure must not have a bucket velocity greater than half the velocity of the entering water.

This has nothing to do with the velocity of discharge, which can be made as little as we like by arranging the areas of the discharging orifices and the areas of the buckets, in a way well understood.

If the weight of the water is quite independent of the speed at which it is moving, then the faster the buckets of a water-wheel can be run the better.

STUDENT.

Finsbury, July 11th.

## LEGAL INTELLIGENCE.

### QUEEN'S BENCH DIVISION.

*(Before* Mr. JUSTICE RIDLEY *and a Special Jury.)*

THE MAGNOLIA METAL COMPANY AND OTHERS *v.* THE TANDEM SMELTING SYNDICATE, LIMITED.

THIS was an action by the Magnolia Metal Company, the Magnolia Anti-Friction Metal Company, and the Magnolia Anti-Friction Metal Company of Great Britain, Limited, for an injunction restraining the defendants from passing off anti-friction metal not of the plaintiffs' manufacture as the plaintiffs' metal by the use of the name Magnolia, and from advertising themselves as manufacturers of Magnolia metal, and from representing that the metal manufactured by them was Magnolia metal, and that their "Tandem C" metal was the same as Magnolia metal. The defendants counterclaimed for libel.

Mr. Bousfield, Q.C., and Mr. R. Newton Crane were for the plaintiffs; Mr. McCall, Q.C., and Mr. T. F. Hobson were for the defendants.

Mr. BOUSFIELD, Q.C., in opening the plaintiffs' case, said that this was an action between rival manufacturers of a white metal called anti-friction metal, used for bearings in machinery and for railway carriage axles, and having the effect of reducing the friction. In the last few years white metals had come into use instead of the old "brasses," and there were a great many competing sorts. The plaintiffs introduced theirs some years ago, and they chose as their trade mark a magnolia flower. They were originally an American company, and then an English company was started, which was replaced by the Magnolia Anti-Friction Metal Company of Great Britain. When this metal was introduced it was largely advertised, and it made a wide reputation. The defendants had made for some years a metal which was called Tandem metal, and was of three kinds, A, B, and C, and they said that their Tandem C metal was the same as the plaintiffs' Magnolia metal. The plaintiffs had not come there to establish the relative values of the metals, but what they objected to was the defendants' saying that their metal was Magnolia metal, and selling it as such. Last year the plaintiffs had obtained an injunction restraining the defendants from passing off their metal for the Magnolia metal of the plaintiffs by making bars similar in form, but this was without prejudice to the question of an injunction against the defendants' using the name Magnolia. The defendants advertised that they guaranteed their Tandem metal to be exactly, chemically, and practically the same alloy as that sold under the name Magnolia at three times the price, and they were now advertising that they manufactured Magnolia metal. They put their own name in the advertisements and on the bars of metal, but this was not sufficient to save them from the imputation that they did not sufficiently distinguish their own goods. The defendants were now issuing a block which would tend to pass off their goods as the plaintiffs'. When the defendants said that their Tandem C metal was the same as the plaintiffs' metal, that meant that they tried to mix the same ingredients in the same proportions. It was important that these white metals should be uniform and pure, and the name Magnolia on the plaintiffs' metal had been a guarantee of these qualities. Counsel referred to "Reddaway *v.* Banham" (1896, A.C., 199) and "Powell *v.* Birmingham Vinegar Brewery Company" (1897, A.C., 710).

Counsel said that he would show that the defendants' metal was not of the same uniformity and purity as the plaintiffs', there being a trace of copper in the former and other differences as well.

Mr. MCCALL, Q.C., said that the only question was whether the plaintiffs had the right to prevent the defendants from using the word Magnolia. But this was concluded by the decision of Mr.—now Lord—Justice Collins and the Court of Appeal in "The Magnolia Metal Company *v.* the Atlas Metal Company" (14 Pat. Cas. 389). This case showed that the word Magnolia did not indicate the goods manufactured by the plaintiffs, but a peculiar kind of metal, and nothing more. In "In the matter of the Magnolia Metal Company's Trade Marks" (14 Pat. Cas., 621) the plaintiffs claimed that they were entitled to the exclusive use of the word Magnolia as a trade mark, but the Court of Appeal held that they were not.

Mr. JUSTICE RIDLEY.—That decision is binding, but the decision in the other case is not, because it is a decision of a question of fact.

Mr. MCCALL said that Mr. Justice Romer had held that the plaintiffs' patent was bad. They could therefore have no patent rights.

Mr. JUSTICE RIDLEY said that the plaintiffs were not suing here on patent rights.

Evidence of trade witnesses having been called in order to show that the term Magnolia metal was understood in the trade to mean metal of the plaintiffs' manufacture,

Mr. Charles B. Miller, the managing director of the Magnolia Companies in London, went into the box. He stated that the plaintiffs had never knowingly permitted anyone to claim to be the maker of Magnolia metal without trying to prevent it. Witness had used the best endeavours to keep the metal uniform.

Cross-examined:—Copper made Magnolia metal "pasty." This meant that it would get out of shape and get hot in working. Witness thought that any one reading the defendants' advertisements would think that he was getting the plaintiffs' metal.

Expert evidence was then given that the plaintiffs' Magnolia metal contained no copper, and its other constituents were uniform, but that the defendants' Tandem C metal did contain a small quantity of copper, and that even the smallest trace of one metal had a very remarkable effect upon another, when, as in this case, there was a considerable difference in their atomic volumes.

Mr. MCCALL, Q.C., in opening the defendants' case, said that there were two questions for the jury to answer. First, were they satisfied that the defendants were passing off their goods as the plaintiffs'? It was said that they were doing so by means of their ingots. But these were dissimilar to the plaintiffs', and Mr. Miller admitted that no one could be deceived by them. They were different in shape and size and in the words stamped on them. The advertisements were not an attempt to pass off defendants' goods as the plaintiffs', but were an offer of substantially the same thing at one-third of the price. The plaintiffs had called no evidence to show that anyone had been deceived by the ingots or the advertisements. As to whether the defendants were entitled to use the word Magnolia, the plaintiffs had not a monopoly protected by a patent, a trade mark, or a secret process. In two cases the Courts had held that Magnolia was the name of the product, and did not connote the name of the manufacture. The witnesses who had been called in this case knew only the plaintiffs' manufacture, and did not prove that there was a well-known signification attached to the word Magnolia. The second question was whether the defendants' metal was substantially the same as the plaintiffs'. The Courts would be flooded with litigation if one rival was entitled to say to another who issued an advertisement, "You have no right to say that you sell the same metal as I do." Was Mr. Beecham to be entitled to say to Mr. Carter, "My pills are better than yours?" and were a judge and jury to try that case—not to speak of the pills—and to say which pill contained more bread or less aloes than the other? If there were any variations between the two metals, they did not render the defendants' alloy one whit worse than the plaintiffs'. Commercially the two metals were the same.

The evidence of experts in analysis was then called as to the constituents of the metals made by the plaintiffs and defendants respectively, it being stated that the plaintiffs' bars were not uniform, but that the defendants' metal was substantially the same as the plaintiffs', except that the former was uniform and the latter was not. It was added that a small quantity of copper would have no effect except to harden the metal slightly. Evidence was given by practical persons who had bought the anti-friction metals of both plaintiffs and defendants. They said that there was no practical difference between them.

By leave of the Judge, expert witnesses were then called on behalf of the plaintiffs to show that their Magnolia metal was superior to the Tandem C metal, as there was less friction with the former.

Mr. MCCALL, Q.C., then submitted that, as there was no evidence of special damage, the plaintiffs had no cause of action so far as concerned the defendants' representation that their metal was the same as the plaintiffs'. He cited "White *v.* Mellin" (1895, A.C., 167), and "Canham *v.* Jones" (2 V. and B., 218).

Mr. JUSTICE RIDLEY said that the plaintiffs were claiming an injunction, not damages.

In summing up to the jury, the learned JUDGE said that there were three questions for them—(1) Did the word Magnolia indicate the manufacture of the plaintiffs'? (2) Was the defendants' metal practically and commercially the same as the plaintiffs'? (3) Did the defendants use the word Magnolia so as to pass off their metal as the plaintiffs' manufacture?

The jury agreed that up to the trial of the action before Mr.—now Lord—Justice Collins, brought by the present plaintiffs against the Atlas Metal Company, that is to say, up to November, 1896, Magnolia did mean the manufacture of the plaintiffs, but they could not agree as to the period of time subsequent to that date. To the second question the jury answered No. To the third question they said that the defendants did not pass off their goods as the same as the plaintiffs', but that they did represent them as similar.

His LORDSHIP reserved judgment.

The case came on upon further consideration on Friday last, when, after argument, judgment was delivered.

Mr. BOUSFIELD, Q.C., said that on the second finding of the jury the plaintiffs were entitled to the second and third injunctions asked for, and generally to the same remedy as was given in "Powell *v.* Birmingham Vinegar Brewery Company" (1894, A.C., 8). Upon that there would follow an inquiry as to damages. As to the first finding, there could be no difference before and after November, 1896, the date of the trial of the action "Magnolia Metal Company *v.* Atlas Metal Company," where Mr.—now Lord—Justice Collins held that the plaintiffs had not an exclusive right to the use of the word Magnolia. This finding of the jury was not a finding against the plaintiffs, and it entitled them to an injunction restraining the defendants from using the word Magnolia in any way, as the finding was that up to that date the word Magnolia meant the plaintiffs' manufacture, and as nothing had occurred to change the position, there having been no *laches* on the plaintiffs' part. No evidence had been given of any distinction between the two periods. As a matter of law, there had been no change in the facts of the situation. There was no evidence to go to the jury of any change, and his Lordship would have been right in directing the jury to that effect. On the third finding, he was willing to take an injunction in its exact terms. On the counterclaim there must be judgment for the plaintiffs, as no evidence had been offered upon it.

Mr. MCCALL, Q.C., said that the first finding of the jury was expressly limited to the period down to November, 1896; but the advertisements complained of were subsequent to that date. The finding of the jury did not refer to a later date than that. It was said that there had been no change; but what greater change could there be than the judgment then given? There was no right to restrain the defendants from using the word Magnolia, unless special damage was alleged and proved, and unless the defendants issued the advertisements maliciously, that was, with the knowledge that they were untrue, "White *v.* Mellin" (1895, A.C., 154). None of these conditions had been fulfilled in this case. Counsel also referred to "Canham *v.* Jones" (2 V. and B., 218) and "Evans *v.* Harlow" (5 Q.B., 624). The case of "Powell *v.* Birmingham Vinegar Brewery Company" was decided on the ground that the process was a secret one, which the defendants could not know.

Mr. BOUSFIELD, Q.C., in reply, said that as soon as it was decided that what the defendants were selling was not Magnolia, the plaintiffs' remedy did not depend on whether Magnolia meant their manufacture, but simply on the fact that Magnolia meant a metal which the plaintiffs had made, and that what the defendants were selling was not Magnolia. This entitled the plaintiffs to the second and third injunctions asked for. He asked further, upon the first finding—and this went beyond the case of "Powell *v.* Birmingham Vinegar Brewery Company"—for an injunction against the use of the term Magnolia at all.

Mr. Justice RIDLEY said that there was some difficulty from the curious form in which the jury had answered the first question. He was of opinion that the word Magnolia continued to mean the manufacture of the plaintiffs after the trial in November, 1896. He did not see why the jury thought that that trial made any difference. But there was no finding as to whether Magnolia continued to have that meaning after that date. Therefore, he did not see how the plaintiffs made out a right to an injunction preventing the use of the word Magnolia, though he could see why they attached importance to the use of the name, and he thought that the case of the defendants on that head was devoid of merit. Whatever might be the proper deduction to make from the first finding, the word Magnolia could not be used in such a way as to pass off the goods as those of the original maker. Upon the whole, he thought that he ought to grant an injunction restraining the defendants from advertising themselves as manufacturers of Magnolia metal and from representing that the metal manufactured by them is Magnolia metal without distinguishing clearly their metal from the plaintiffs' metal, and an injunction restraining the defendants from representing that their Tandem C metal is the same as Magnolia metal. He would not, however, grant an injunction in the terms of the third finding. There would be an inquiry as to damages, and judgment for the plaintiffs on the counterclaim.—*Times.*

## LAUNCHES AND TRIAL TRIPS.

ON Friday last, the 8th inst., Messrs. McMillan and Son launched from their yard at Dumbarton the s.s. Mainstay, which has been built to the order of the Steamship Mainstay Company, Limited, of Liverpool, James J. Mahon, manager. The vessel and her machinery have been constructed under the superintendence of Messrs. Flannery and Tritton, consulting engineers, of Liverpool and London. Her dimensions are 340ft. by 45ft. by 28ft. 9in., and she is designed to carry a deadweight of 5600 tons on a light draught. There are seven powerful steam winches, large marine type donkey boiler, and latest appliances for the rapid discharge of cargo; also a large fresh-water condenser. The propelling engines are of the triple-expansion type, having cylinders 24in., 40in., and 64in. by 42in. stroke, and will be supplied with steam from two large boilers working at a pressure of 180 lb. per square inch, and the latest appliances for economy of fuel will be fitted.

On Wednesday, July 6th, Sir Raylton Dixon and Company, Limited, launched from their Cleveland dockyards, Middlesbrough, a large mail and passenger steamer built to the order of the Royal Mail Steam Packet Company, of London. To suit the requirements of the trade which the vessel will be engaged in between this country, Portugal and South America, many special designs have been introduced in her construction. She is built to Lloyd's highest requirements under special survey, three-deck rule, and to the Board of Trade regulations for carrying passengers. Her principal dimensions are:—364ft. by 45ft. 2in. by 28ft. 1in., with a gross tonnage of about 4000 tons, and a deadweight carrying capacity of about 3000 tons on a light draught of water. The vessel will be fitted with engines of the triple-expansion type constructed by Messrs. Thos. Richardson and Sons, Limited, Hartlepool, having cylinders 28in., 46in., 77in. by 48in. stroke, supplied with steam by four single-ended boilers 13ft. 6in. by 11ft. 6in., fitted with Howden's forced draught, and one auxiliary boiler 10ft. 7in. by 10ft., working at 180 lb. pressure, which it is expected will drive the steamer 13 knots an hour. The vessel has been built under the supervision of Captain Hicks and Mr. Arthur, the chief resident inspector being Mr. Westland. On leaving the ways she was named Severn by Mrs. Hicks, wife of Captain Hicks, of Southampton, the marine superintendent of the company.

On Saturday morning, July 9th, the s.s. Azul, a fine large steel screw steamer, built by Messrs. Wm. Gray and Co., Limited, to the order of the Buenos Ayres and Great Southern Railway Company and Arthur Holland and Co., of London, left West Hartlepool for her trial trip. She is specially designed to carry a very large number of cattle and sheep on her decks, and a large measurement cargo in her holds. She takes Lloyd's highest class, and is of the following dimensions:—Length overall, 336ft.; breadth, 48ft. 9in.; and depth, 24ft. The deck erections consist of a full poop, long bridge, and topgallant forecastle. The saloon and captain's and officers' rooms and passenger accommodation are fitted on the bridge. The hull is built with deep frames, cellular double bottom for water ballast, and a large afterpeak tank. Six steam winches, steam steering gear amidships, and screw gear aft, patent direct steam windlass, marine type donkey boiler, stockless anchors, and a complete outfit, have been fitted for a first-class cargo boat. Three-cylinder triple-expansion engines have been supplied by the Central Marine Engine Works of Messrs. Wm. Gray and Co., Limited. The cylinders are 24in., 38in., and 64in. diameter, with a piston stroke of 42in., and very large steel boilers, having a working pressure of 180 lb. per square inch, will give an ample supply of steam. The Azul went out in the early morning, and after being manœuvred for the purpose of having her compasses adjusted by Mr. Berry, a full-speed trial was made, the mean result of several runs along the coast giving an average speed of 11½ knots.

The fine twin-screw liner Hongkong Maru was successfully launched on the 7th inst. from the yard of Sir James Laing, at Sunderland. The vessel has been built to the order of the Oriental Steamship Company, of Japan—Toyo Kisen Kabuisiki Kisha, of Tokyo—and is the second ship built by Sir James Laing for that company, and is intended for fast passenger and cargo service between China and Japan and the United States. Her dimensions are:—Length, 431ft.; breadth, 50ft. 6in.; depth moulded to upper deck, 32ft. 6in. The vessel has been constructed of steel throughout, under the supervision of Messrs. Flannery, Baggallay, and Johnson, of London and Liverpool, to Lloyd's highest class, as well as to the rules of the Imperial Japanese Government and the British Board of Trade. Accommodation has been provided for a large number of first-class passengers, second-class passengers, and about 250 emigrants. There is space in the hold for about 500 tons of cargo, and suitable winches and deck gear are provided to handle this cargo with every speed. The vessel is also fitted with mail and silk rooms. The engines, which are built by Messrs. George Clark and Co., Limited, of Sunderland, have been designed with a view to the high speed on service of nearly 17 knots per hour, and are of the following dimensions:—28½in., 46in., and 72in. cylinders, with a stroke of 48in., taking steam from four double-ended and one single-ended boilers. The engines are in duplicate, and there is also a powerful auxiliary boiler and a very complete installation of machinery for freezing, electric light, steering gear, and other purposes.

## EXPRESS ENGINES, HIGHLAND RAILWAY.

IN our last impression we illustrated two fine locomotives, designed by Mr. D. Jones, for the Highland Railway, and on page 30 we gave the dimensions, which need correction.

The particulars first given refer not to the Sir George, but to a very heavy class of express goods engine, designed by Mr. Jones. The dimensions of the Sir George are as follows:—

| | | | |
|---|---|---|---|
| Cylinders, 18in. diameter, 24in. stroke. | Tractive force 104 lb. per lb. of effective cylinder pressure. | | |
| Weight on bogie | 15½ | tons, dia. of wheels, | 3ft. 9in. |
| ,, driving wheels | 15 | ,, ,, ,, | 6ft. 3in. |
| ,, trailing ,, | 14½ | ,, ,, ,, | 6ft. 3in. |
| ,, tender (with coal and water) | 31½ | ,, ,, ,, | 3ft. 9in. |
| Heating surface—Tubes | 1127 | sq. ft. | |
| ,, Fire-box | 115 | sq. ft. | |
| Fire-grate area | 18·85 | sq. ft. | |
| Boiler pressure | 160 | lb. per sq. in. | |
| Tender contents | 2300 | gals. water, 4 tons coal | |

Automatic vacuum brake.

The dimensions of the Loch Insh we have already given, as stated, on page 30.

IN connection with the exhibition of acetylene gas apparatus at the Imperial Institute, it may be stated that this illuminant is employed each evening for lighting up the Lower West Central Gallery.

## H.M.S. AMPHITRITE

WE briefly recorded in our last impression the launching of her Majesty's ship Amphitrite; the space available in our pages at the time we devoted to a summary of the speech by Sir William White, in which he criticised the critics of the more recent additions to our Navy.

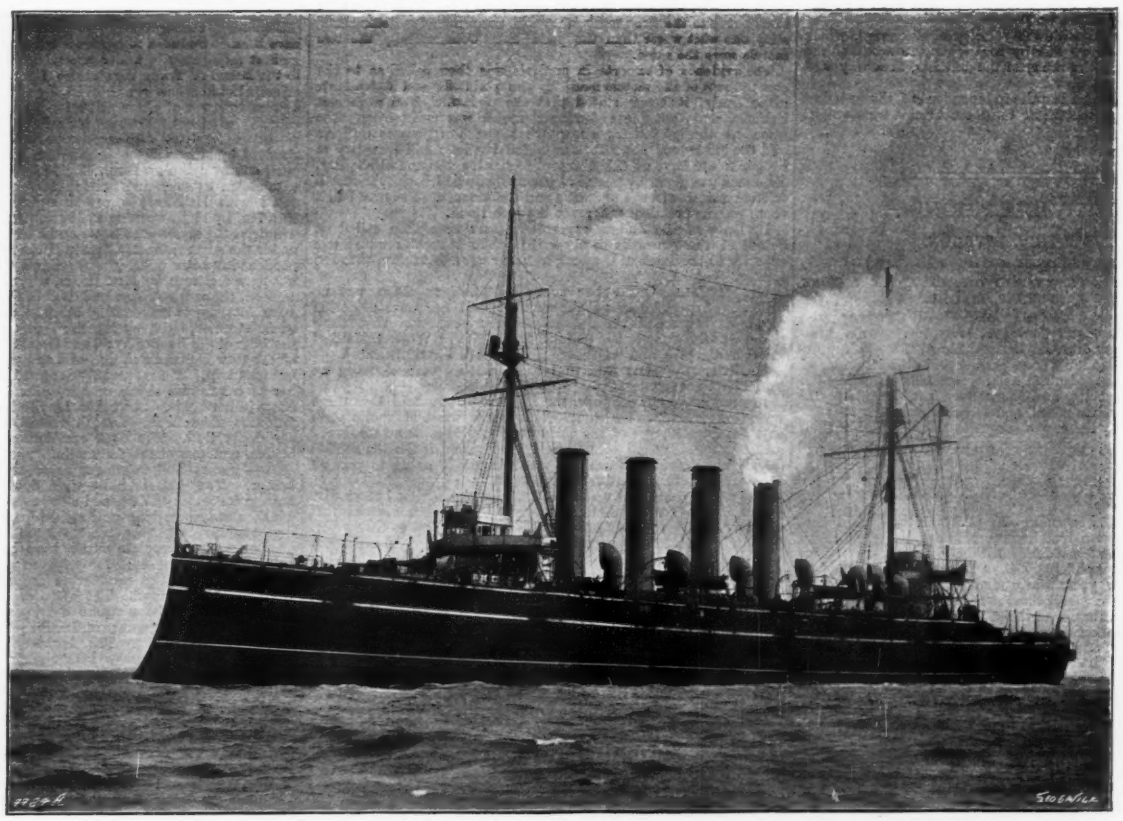
We now give below an engraving showing the completed Amphitrite as she will appear at sea, and in a subsequent impression we shall illustrate her engines. We are indebted to Messrs. Vickers, Sons, and Maxim, Limited, her builders, for the following description of the ship.

The Amphitrite is 435ft. in length between perpendiculars, but the overhanging stern and the projecting ram make the length overall 463ft. Her beam over the sheathing is 69ft., and her moulded depth to the upper deck is 39ft. 9in. The mean load draught of the vessel is 25ft. 3in., at which draught the displacement is 11,000 tons. The hull of the vessel is constructed of Siemens-Martin steel, the heavy external framing of the bow and stern as well as the propeller brackets and the rudder frame being phosphor-bronze castings. The rudder is of the balanced type, and the stern curved outwards under the water, so as to form a formidable ram; up to a height of about 9ft. above the water line the steel shell of the vessel is sheathed with teak planking and coppered. Two long bilge keels to prevent rolling are also fitted. The vessel's bottom, amidships, is constructed on the cellular principle, the inner skin being carried from the protective deck at one side down and up to the protective deck at the other side. The double bottom is minutely sub-divided into water-tight compartments. By water-tight bulkheads and water-tight flats the vessel is throughout closely sub-divided. The protection consists of a curved armoured deck of steel plating 4in. thick at the crown, which extends the whole length of the vessel. Under this deck, which is raised in way of the engines, are also placed the steering engines and gear, the capstan engines, the air-compressing machinery, and all the magazines, shell-rooms, and torpedo-rooms. The coal bunkers, which have a capacity of over 2000 tons of coal, are arranged along the sides of the boiler-rooms, and along the sides of the vessel on the protective deck above the engines and boilers.

The armament of the vessel, as will be seen from the statement, is of a most powerful description. There are sixteen 6in. quick-firing guns, twelve 12-pounder quick-firing guns, three 3-pounder quick-firing guns, two 12-pounder boat and field guns, and eight ·45in. Maxim machine guns. The 6in. guns are mounted as follows:—Two on the forecastle head, two on the upper deck aft, the remaining twelve being mounted on the broadside in armoured casemates constructed of Harveyed steel armour, 6in. thick. Of these twelve casemates eight are on the main deck level, and four on the upper deck level. The 12-pounder guns are mounted four on each broadside on the upper deck, two on the upper deck under the forecastle, and two right att on the main deck. The 3-pounder guns are mounted on the boat platform deck. The Amphitrite is fitted with two under-water broadside torpedo tubes, placed under the protective deck in a special compartment forward. The 6in. guns and 12-pounder guns will be supplied with ammunition through armoured tubes, extending from the protective deck to the deck on which the guns are worked. An ammunition passage is arranged on each side of the ship, extending for the whole length of the machinery space below the protective deck. The passage is completely protected by coal on top, sides, and bottom, so that the ammunition need never be exposed to gun fire in its course from the magazines to the guns.

The conning tower is placed forward, and is built of Harveyed steel armour 12in. thick. From it are led voice pipes, telegraphs, &c., down through a forged steel tube 7in. thick to the protective deck, and forward and aft underneath this deck to the engine-room, torpedo rooms, and steering positions. Above the conning tower is a navigating bridge with chart-room, steering standard, telegraphs, &c., required in the ordinary navigating of the ship. The vessel is fitted with two steel masts. Unlike her larger sister ship the Powerful, these are not fitted with fighting tops, but on the top of the mainmast pole is fitted large semaphore signalling apparatus. There are five steam steering positions, one on the forward navigating bridge, one on the aft bridge, one in the conning tower, and two under the protective deck. Efficient hand gear is also fitted aft under the protective deck.

The vessel is lighted throughout with electricity, there being three dynamos supplying six powerful search-lights, and the incandescent lights, which number about 850. The search-lights are placed one in special top on each mast, and two on each bridge. The ventilation, both natural and artificial, is most complete; there are four large ventilating steam fans for ventilating the main spaces of the ship, and one electric fan for cabin ventilation. On the deck are arranged two boat-hoisting engines and two coal-hoisting engines, heavy derricks being also fitted for hoisting the boats inboard and over the side. The boats, which are fourteen in number, include a 56ft. steam pinnace and two steam launches, which are stowed on a steel boat deck, extending from the forecastle to the after bridge. The total complement of the vessel, including the admiral's retinue, will be 718 men, for whose comfort every provision is made. The officers' quarters, which include a spacious suite for the admiral, are arranged mostly on the main deck abaft the machinery, the crew and petty officers being accommodated on the upper deck under the forecastle, and on the main deck alongside and before the machinery spaces.



H.M.S. AMPHITRITE

## A RUN ON THE CHEMIN DE FER DU NORD.

IN the year 1896 the writer twice had occasion to travel by the afternon boat train from Calais to Paris, and was much struck by the admirable work performed by the engines of the Chemin de Fer du Nord engaged on that service. The first time, the run from Calais town to Amiens, a distance of nearly 102 miles, was performed in 111 minutes, with a train of about fourteen four-wheeled carriages, and the second time in 112 minutes with eleven carriages; while on the second occasion, the Amiens-Paris section, 81 miles, was run in exactly 85 minutes. This work was all done by the earlier classes of four-cylinder compound engines.

A short time ago, through the kindness of M. du Bousquet, locomotive superintendent of the Chemin de Fer du Nord, the writer was enabled to make the run from Amiens to Paris on the engine of the afternoon boat train, which was of the very latest class of locomotive put upon the line, of the same general design as the former engines, but with a much bigger and higher pitched boiler. The actual engine in question had only been out two months, and even differs in some few points from her sister engines Nos. 2158 and 2160, having an extended smoke-box, and a slightly longer fire-box. The great height of her boiler gives her a fine appearance, which is not spoiled, as in so many French engines, by every possible tube and piece of machinery being put outside in the most conspicuous place; though it must be admitted that not so much care has been taken in this respect as with most British engines. The coupled wheels are 6ft. 11in. in diameter, with the great wheel base of 9ft. 10in. The high-pressure cylinders are outside, and the low-pressure inside the frames.

The tender is very large, and runs on two four-wheeled bogies. The whole is painted a chocolate brown. The line between Amiens and Paris consists, first, of a long uphill piece, rising, on an average, at about 1 in 330, with some short level pieces and two slight descents; then of a corresponding downhill stretch of much the same steepness, with one short ascent two-thirds of the way down. This brings us to near Creil, after which, with a long rise of about 1 in 200, and a similar descent, the line reaches the outskirts of Paris.

Our train consisted of fourteen vehicles, with thirty-one axles in all, of which I was informed the total weight was about 190 tons.

Owing to a late start from Calais, and delays between there and Amiens, we left the latter station about a quarter of an hour late. We had a little trouble in starting, as the engine did not move when the regulator was opened, and steam had to be admitted direct to the reservoir between the two sets of cylinders, from the safety valve of which it blew off furiously. Then, as we started the wheels began to skid; when, however, we had gone a few yards we had no more trouble, though we did not get up speed very quickly, taking nearly 4 min. over the first 2½ kiloms. When we had got into speed the regulator was opened wide, and the reversing gear put in a position which cut off steam in the high-pressure cylinders at 50 per cent., and in the low-pressure cylinders at 65 per cent., this late cut-off in the former being due to their small diameter, of little more than 13in. In fine weather, but with a considerable side wind from the west, we breasted the long hill which stretches from Amiens to kilom. 86 in fine style, reaching 60 miles an hour at kilom. 121, and keeping it to kilom. 116, and again attaining that speed at kilom. 107 and holding it to kilom. 88, while the average speed from kilom. 121 to kilom. 85 was also 60 miles an hour. All this time the steam pressure was very evenly maintained; the firing was regular, about three shovels of briquettes being put on every three minutes.

At the top of the hill the regulator was half closed, and we did a very steady descent into Creil, with the reversing gear in the same position as when we were going up hill. From 85 kiloms. to 53 kiloms. the average speed was 67 miles an hour, though we only touched 70 for one kilom. The running was generally smooth, but we had some rather bad lurches in places.

At Creil the regulator was shut, and we slackened speed, losing exactly half a minute thereby, but after passing the station we soon got into speed again, and shortly afterwards entered on the most trying part of the journey—the long stretch of 20 kiloms., almost all at 1 in 200, and with no down-hill pieces at all. Here some magnificent work was done, the last three kiloms. taking only 2 min. 6 sec., which equals 53·2 miles an hour; the whole distance, from 48 kiloms.—where the ascent begins—to 27 kiloms., just over the brow of the hill, was run in 14 min. 7 sec., or at 55·4 miles an hour. When we take into consideration that the height ascended was 275ft., it becomes obvious that the performance was one of great merit.

On the succeeding down-hill piece, the regulator again being half shut, some fairly fast running was done, 1 kilom. being traversed in exactly 30 sec. (74·5 miles an hour), while 74 miles an hour was kept up for 7 kiloms. This, however, was obviously not nearly so fast as the engine could run on such gradients, if pressed. But we were now before time, and on reaching the outskirts of Paris, went more leisurely. Under Montmartre, and a little less than 800 metres from the end of our journey, we were eventually stopped by signal, after having run 80·6 miles in just under 82¼ min., an average speed of 58·8 miles an hour. We were then before time, although we had left Amiens a quarter of an hour late. With faster running down hill, and an absence of side wind, the run might easily have been done in considerably less time.

The run was in every way admirable, the engine performing her work with great ease, and her running and steaming qualities being excellent, and reflecting great credit alike on her designer, and on her builders, the Société Alsacienne, of Belfort.

## ELECTRICAL ENGINEERS' SPECIFICATIONS.*

By J. ALEC. MCLAREN.

(*Concluded from page* 43).

*Pumps.*—Little attention is given to such accessories as pumps, and the kind used is generally the one which costs least, but it would well repay the station engineer if he gave more consideration to this part of the plant. Most engineers, however, are in utter ignorance as to the performance of their pumps, and if they only knew the enormous amount of steam they swallow, they would not keep them on the premises a day longer than necessary; it would pay them over and over again to sell them as scrap iron and buy something better. Slow running, direct-acting pumps without any fly-wheel cannot possibly be economical, they require to carry steam so far along the stroke to keep them from stopping that the steam must exhaust not much under the initial pressure, whereas a pump which runs as fast as possible with a large fly-wheel has a much better chance, because the steam can be cut off earlier in the stroke and allowed to expand while the fly-wheel gives out its energy. The more cylinders about a station the worse will be the efficiency, and it will always pay when feasible to work the pumps from the main engines. These slow-running pumps with their little, unjacketed, badly-clothed cylinders, are nothing more or less than mechanical parasites on the installation. There appears to be an opening for a good economical pump. A certain engineer, who, by the way, takes nothing on trust, tested his pumps properly as well as everything else on his station, and he got some positively alarming results; he found that the pumps used in the best cases above 300 lb., and in the worst above 600 lb. of steam per pump horse-power per hour. Consequently, he is having them all replaced, and they are quite new pumps. In the same station they can turn out electricity with engines using under 12 lb. of steam per indicated horse-power, so that the phenomenal economy of the engines is to a great extent counterbalanced by excessively wasteful feed, and circulating water pumps. When buying his new pumps, the guarantees which were given him were 46 lb. of water per pump horse-power. Injectors might often be used when cold water is taken for feed-water; and the result cannot be beaten, as all the heat returns to the boiler.

*Pipes*, as a rule, have a section of their own, and they need it. If there is any part of the contract that requires care in estimating, it comes under the heading of "Pipes;" and many successful tenderers for this work have afterwards regretted that theirs was the successful one. The fact of the matter is, you cannot put too large a price on; and without the price is a very good one, you are much better without it. It frequently happens that the firm which supplies the boilers or engines gets the pipes as well; but sometimes it goes to an outside firm altogether, which makes it worse for them. Now, from the day the first piece of machinery is delivered until the station is thoroughly completed, the firm that supplies the pipes must have a man there practically all the time. Not just a workman, but a capable man who can undertake the designing and arranging of the pipe system. Of course the pipe arrangement has all been laid down on paper, the makers of all the different parts of the plant have been written to, and, after many delays, particulars of the position and size of every flange have been received, so that he gets all his pipes and valves ordered, and only leaves making-up pieces at the end of every pipe line. So far, all this can be done in the drawing-office; but when the machinery turns up, it will be found that many of the flanges are totally different to the sketches sent. Sometimes the style of feed pumps has been changed at the last minute. The pipes have to be supported properly from any convenient place, and plumbers' work, such as drain pipes, steam trap drains, &c., has to be done, so that this work is considerably above what is considered to be the average workman's ability. Although not so closely packed as the pipes on board a steamship, there is a good deal of complication and cross-coupling in this work. The main steam pipes are either laid down in the well-known ring system, or are placed in duplicate to each engine; the latter being the more reliable plan, but also the more expensive. The ring system, however, with plenty of stop valves suitably placed, is safe enough for commercial purposes. Every boiler must have an independent blow-off pipe running to the sump. All engines and pumps must be connected to the condenser, and also must have valves to exhaust into the atmosphere when wanted, and when the condenser is an independent one the pipes and valves increase in number. The pumps must pump through the economiser, or direct to the boilers at will. They must have connections to act as fire engines, when necessary.

The condensed water on its way to the hot well must pass through oil filters. Steam separators are plentifully distributed. All drains from the engines must be collected and taken to the hot well or sump. Jacket water must be taken off by steam traps, and led to the hot well. Steam traps are things engineers are very strong on, and are laid about thickly. It is quite customary for one engine to have four traps connected to it, and they are a greater source of trouble than almost anything else in the station. Then the pipes must be properly covered, and pass tests, which are rigidly enforced to one deg. Fah., as to the amount of heat which escapes through the lagging. In the case of an alteration and extension to the pipe work in a comparatively small station I know of, there are no fewer than seventy valves to be provided. So it will be seen it is not all plain sailing putting in the pipes.

*Material and construction of pipes.*—The main steam pipes are generally specified to be made of lap-welded mild steel. In the case of bends, the lap must be in the neutral axis, the only difference being in the manner of fastening on the flanges, and here we have a great variety of opinion as to which is the best method. One way often used is by screwing wrought iron or cast steel flanges on the pipe, and rivetting over the ends, and also brazing the other side of the flange. The principal objection to this is that the screwing weakens the pipe so much by nicking deeply into it, and there is too much room for bad workmanship to pass unnoticed. A good form of flange is made of a strong angle iron, bored out to fit on the pipe and shrunk on, then riveted to the pipe. Sometimes cast iron flanges are used, and are made very strong. They are screwed on to the pipe, and sometimes are riveted as well. Electrically-welded pipes are coming into use, and have their faults as well as the others. In welding anything a good deal of trust is put in the men who do it. There is here again plenty of opportunity for indifferent workmanship, especially when the flange joins the pipe. The first cost of these pipes is large, and you must not order any special size of flange to suit existing flanges, as the price for special flanges runs out to somewhere about £2 per flange extra. Copper is seldom asked for, excepting for bends; sometimes bends of copper are put on exhaust pipes. Cast iron, of course, is the cheapest form of pipe, but the argument regarding bad workmanship comes into full force here. I do not wish to insinuate that the average mechanic is always on the lookout to put in bad and slovenly work, but pipes are often quite neglected all through. Great care is taken in the moulding, machining, and testing of the cylinder of an engine, but very often the pipes are never tested at all. To an iron-moulder a pipe is a pipe. It does not matter whether it is a steam pipe or a drain pipe, they get the same care in moulding; and many an accident has occurred through uneven thickness of metal. Another objection to cast iron is that pipes do not always fit into their places properly, and the erector has to pull them together, often straining the flanges to the breaking point, and when it does break it does so without warning. Cast iron, like everything else, has its champion, and he is to be found at the General Electric Company's works at Schenectady. They had wrought iron piping with cast iron flanges and packed joints; the consequence was they had a gang of men constantly employed on Saturday night and Sunday repairing joints. So the engineer thought if he stayed at home and did not see what others were doing he could not expect to get the best results. So he went to Boston, New York, and Brooklyn and several other places, and in the whole course of his journey he failed to find a single plant that was not troubled with escaping steam when they were carrying high pressure. He then decided that he must use cast iron pipes, and gave for his reasons:—(1) "If cast iron was good enough for valves, it certainly must be all right for plain piping, as it was a much simpler casting to make perfect. (2) I conclude that by using cast iron I could cut the number of joints down to about one quarter of what would be required by the use of any other metal." The pipes he was dealing with were 14in. diameter, steam pressure 160 lb. The metal was 1¼in. thick in the body and 2¼in. in the flange, the flanges were bolted together by twenty bolts 1¼in. diameter. This proved successful, and "he was happy ever after." The smaller piping to the pumps, &c., is either of wrought iron or copper, boiler feed pipes wrought iron, but not always, as at the Yorkshire House-to-House Station they are cast iron, 4in. diameter. Occasionally every detail is given as to how the pipes should be made, and here is a portion copied from a specification:—"The steam pipes of steel, shall be made of plates ⅛in. thick—I suppose ⅜in., which is ⅛in. more, would not do. The angles of flanges ⅜in. diameter in the body, and 1¼in. thick—⅜in. is known in the shops as ⅜in. under ⅞in., and to say the least it is strange why ⅞in. should not do. They must be faced on the surface and the edges, and bored for the bodies of the pipes, with slightly recessed spigot and socket joints. The flange shall be secured to the body of the pipe by twelve ⅞in. bolts. The stop valve shall have wrought iron cross bars and pillar bolts, with spindles, glands, valves, and seats of gun-metal. The cross bars shall be shaped in a slotting machine—and not turned—and chased to received the screwed spindle. All bolt holes shall be bored to the correct size, and all bolts shall be turned throughout their entire length, and at the point, and faced up under the head. All nuts shall be truly faced and shaped both top and bottom, and finished bright. The pipes shall be fitted accurately together, so that the flanges shall come metal to metal without straining and the joints shall be made without any kind of inserting rings, and the flanges shall be screwed practically metal to metal, and made perfectly steam and water-tight." In this case it will at least be admitted that "pipes" have had some attention paid to them as to how they should be manufactured. In going through these specifications, it is often amusing to notice how comparatively trivial details are gone into thoroughly, and the most important parts scarcely referred to. You can always tell one prominent electrical engineer's specification by the size of stop valve where he stipulates; 18in. is his favourite size, and it does not matter much what size you make the cylinders as long as you supply an 18in. stop valve wheel. One would think that in the specification I just quoted from regarding the pipes, that everything else would be dealt with similarly; but such is not the case. The connecting-rod had to be 5ft. 8in. centres, but the stroke of the engine was never referred to. You could make that what you liked. It is difficult to say what special virtue there is in a 5ft. 8in. connecting rod, evidently it is quite regardless of the stroke. If this specification had come from a manufacturer, the conclusion that would at once be come to would be that he had some old ones to use up.

*Engines.*—As almost every type of engine is being used for the production of electricity, it will not be amiss to look for the reason of this, to consider some of the leading characteristics, and to come to some conclusion as to which is the best kind. There is no other class of engine of which so much is required. It must be an engine that can be relied upon to be always fit for work; it must be able to start up quickly, to run for long periods without stopping, and above all, to run steadily always, no matter how the load may vary, which it does to a great extent, anything from ⅛th full load to 20 per cent. over-load can be expected daily. When compared with a locomotive, we find that this engine only runs from two to three hours at a stretch, then has a long stop, and once a week is overhauled in the running shed; if anything goes wrong, such as a bearing getting hot, it can be eased up or stopped altogether, without causing inconvenience. But the electrical engine cannot be stopped, when perhaps a town is depending on it for light. We often hear of the wonderful performances of marine engines, making runs to Australia without stopping; but by the time they get near the end you will find glands blowing hard, water flying about all over, big ends knocking like steam hammers. I have known the engine-room to be so full of steam that the chief engineer, when coming down the ladder, thought he had reached the bottom when three steps up, and damaged himself. There must be no escape of steam from the electrical engine, as any moisture on the alternator is deadly. For the same reason water must not be used for cooling bearings, and great care has to be exercised in designing the oiling arrangement so that none can get on the machine. The standard mill engine has a much easier life; its load is practically constant, one or two men look after it constantly, while every Sunday it is available for repairs. It would be rash to say what will be the future standard type of electrical engines. The marine engine has come through its period of evolution, from the steeple, beam, side-lever, and horizontal, to the present-day inverted type, which has no rival. The mill engine is invariably the heavy, slow-running Corliss engine, and is also unassailable; while the engine for electrical work as yet has no recognised form. Every kind is being used at present, and are undergoing the process which leads to the survival of the fittest. Very often in the same station you will find four or five different styles, and all by different makers. If we take the Leeds Central Station as an instance, we will find they have large horizontal slide-valve engines, Corliss engines, other patent valve gear engines, and high speed enclosed engines; and this is no exception to the rule. The great variation in the speed, which is anything from sixty revolutions to several thousands in the case of the Parsons' turbines, to a great extent accounts for this, and to-day the style of engine is largely settled by the speed of the dynamo or alternator. Direct-driven plants, which hold the field just now, require a good speed, which debars the Corliss engine, so it can be struck off the list. As every electrician knows, it is much more difficult to run in parallel with direct-driven plants than with belts or ropes, and for good parallel running you require to run at least at 150 revolutions with two-crank engines, and the higher the speed the easier the running, but with three-crank engines 125 revolutions give capital results when in connection with an ironclad type of alternator. The only drawback to a plant running so slow as this is the increased first cost, and the makers of high-speed motors get many an order on that account. The horizontal order of engine is rapidly being replaced by the inverted owing to the amount of space occupied, and it is now possible to put a 600-kilowatt plant on less ground than was used a few years ago for 80 kilowatts. Looking at the high-speed kind—that is, engines running at 300 to 500 revolutions per minute, they take up a minimum amount of room and cost less, but they are never so economical, and have a comparatively short life, and when anything goes wrong it means a smash up all over. Many of them are dependent on forced lubrication, which occasionally gives out; while they have in their favour good governing and parallel running qualities. In my opinion the engine which fulfils most of the present-day requirements and gives most satisfactory results is the ordinary inverted triple-expansion, surface-condensing engine. It has three cranks, giving a good turning moment; it has a large number of expansions of steam, giving economy; it can be made to govern perfectly, it has a condenser which provides a good vacuum, air, circulating, and feed pumps are worked by the main engine, and it is entirely self-contained. There is a great deal to be said in favour of having an engine entirely self-contained—it is altogether; there are no little independent pumps to deal with, and to start up simultaneously with the large engine, and it has its own condenser, which is a great advantage. With many engineers a vacuum is not of much consequence. It does not much matter whether the gauge shows 18in. or 28in. There is no great secret in getting a good vacuum. All you require is plenty of cooling surface, plenty of water, and a good air pump, and you get it; and it is worth having, because if we take the referred mean pressure in the low-pressure cylinder to be 21 lb., and let us suppose the vacuum in the cylinder to be 20in.—and it is often much less than this—if it be increased to 26in. that means a difference of pressure of 3 lb., which brings the mean pressure up to 24 lb., and adds 14 per cent. to the power of the engine, which is given almost gratis, and we may take it as a rule that an engine with its own condenser will do considerably more power than one with a separate condensing plant. With most engineers a condenser is a condenser, and it does not matter whether it is close up to the engine, or in as remote a part of the engine-house as possible. With independent condensers which do the work for several engines, you never get a good vacuum in the cylinders—20in. may be taken as a maximum. Very often it happens that it is only that in the condenser, especially in the case of a jet condenser. Then, again, when all the engines in a station are connected to one condenser, and it breaks down, it is a serious matter, and is equivalent to putting on suddenly 25 per cent. more load at least all round, which would be awkward when the plants were working at full power. It may be argued that there should be a spare condensing plant; but that means considerable expense, and more complications in the pipe work. Not only should every engine have its own condenser, but it should work it, especially in small-sized units, as in a certain case where a small engine has a separate condenser worked by independent pumps, the arrangement is such that, instead of driving these pumps, it is more economical to run non-condensing. When extreme economy is demanded the cost of the engine materially goes up, as in the slower-running engines a very complete system of jacketing must be carried out, cylinder ends and pistons must be polished, and every part of the cylinders must be well-covered with lagging. The bearing surfaces must be very large all over, to provide for continuous running, and very often are specified to be made of Magnolia metal. The valves must be balanced against the steam pressure; and as previously stated, the engine must be large for its work—that is to say, the terminal pressure in the low-pressure cylinder must be low. Unfortunately, however, economy often gets scant consideration, and a few pounds in the first cost decides where the order will be placed. When settling upon the size of engine required, it sometimes is difficult to know what size to call it, as very often it is put in this form:—"The generator must be capable of producing 200 ampères at from 2000 to 2200 volts when running at 150 revolutions. The engine will be supplied with steam at 125 lb. pressure in the boilers—which are 40ft. away—it will be connected to a condenser (50ft. away), where the guaranteed vacuum will be 25in., it must be capable of working most economically at three-quarter load; and will be able to do 25 per cent. over load without any reduction in the speed, and also must do the full power when working non-condensing." Guarantees as to the steam consumption at different powers under these conditions are then asked for. The clause concerning governing is a very important one, and very stringent, and sometimes impossible conditions are laid down. It is customary to stipulate that "the governor must be able to control the speed within 1 per cent. of the normal, from half load to full load, and when all the load is suddenly thrown off the speed must not vary more than 4 per cent." Another stipulation which is thrown in is that "the governor must have provision for altering the speed of the engine as much as 10 per cent. above to 10 per cent. below the normal while the engine is running." Much more trouble has been caused by attempting too fine governing than by aiming for moderate governing. The finer the governing the greater the danger of touching the hunting point, and when that is reached away goes the parallel running, and the engine would run infinitely steadier without one. When a good governing engine is placed alongside bad governing ones it has a rough time of it, as when the load increases the other engines gradually slow down and do not do their share of work, while the good engine is struggling along to keep up to its speed with a greatly increased load, and probably pulling some of the others round. Electricians are gradually coming to the conclusion that it is better to govern to 5 per cent. than to 1 per cent., and for facility of getting in and out of parallel even rougher than that is suggested. Again, with fine governing it is impossible to have a large range in the variation of the speed, which is wanted for synchronising purposes.

*Alternator.*—I will refer very briefly to the leading particulars usually specified in the case of an alternator.

*Type.*—Either open coil revolving armature, with fixed magnets, or a fixed armature and revolving magnets, commonly known as copper machines and ironclads respectively. The copper machine is a more efficient one than the ironclad, but not so reliable, and is more difficult to manipulate in paralleling. It takes a very high-class plant to give a combined efficiency of 75 per cent. with an ironclad alternator, while with a copper machine 85 per cent. can be got easily.

*Periodicity.*—The number of complete periods of alternations per second is stated, and as a rule is either 50 or about 80.

*Temperature rise.*—After a twelve hours' run at the normal output, no part of the armature or magnet shall have a temperature of more than 60 deg. Fah. above that of the surrounding atmosphere. If the temperature exceeds that limit by more than 10 deg. Fah., the alternator may at the option of the engineer be totally rejected.

*Parallel running.*—The machine must be so constructed that it is capable of running in parallel at all loads. The time to speed up a plant lying idle, with the cylinders warm, and to put it in parallel with a plant running fully loaded, must not exceed two minutes.

*Minimum insulation resistance.*—The amount of resistance stipulated by different engineers varies enormously, as the two following cases will prove:—15 megohms, armature conductor to framework, in one case; 3 megohms in the other. 5 megohms field magnet to framework in the first instance, 1000 ohms in the last. The insulation between the armature and the framework must be capable of resisting piercing by a spark of anything between 4000 to 6000 volts alternating electromotive force, according to the opinion of the engineer. So it will be seen that there is some diversity of opinion as to the amount of resistance necessary.

*Exciter.*—An exciter of approved design must be provided with the alternator, and the percentage of excitation required by the alternator must be stated. Then an efficiency must be guaranteed. These represent the usual stipulations issued by the electrical engineer, and except the clause as to the resistance, they are practically the same in every specification.

*Conclusion.*—Electrical engineers' specifications, although they are most emphatic and concise, are by no means always adhered to. In some cases horizontal engines have been asked for, every detail mentioned, drawings got out, and the specification prepared accordingly, while they ultimately take vertical engines. Again, the speed is specified, that it must not exceed 100 revolutions, and they straightway go and buy one running 330 per minute, and so on. They are all very well in their way; but when a specification is given which goes into great detail, and demands many extra fittings, and an abnormally large outfit, the tendency is to make the contractor do as little more as possible, and if anything be forgotten it must be paid for extra. Then it is rather annoying when an insertion is insisted on which partakes largely of the nature of a fad, and upsets present arrangements. When every part of the design is stipulated it effectually puts a stop to any improvement that might have been effected had the manufacturers a freer hand, and as a rule the purchasers would get just as good a plant if they put it into the hands of any of our leading firms who have a reputation to keep up, without binding them down at every point. Some of our old-established firms who do not encourage electrical

* Read before the Yorkshire College Engineering Society, January 31st, 1898.

work, give as their reason, their aversion to the specifications. Finally, a firm can tender away every day, they can specify in the case of the engine that it shall fulfil every condition mentioned in the specification, it shall govern perfectly, run continuously, give 94 per cent. mechanical efficiency, use not more than 12 lb. of steam per indicated horse-power per hour, the workmanship and finish perfect, the price an average one; yet all this is merely a waste of time, ink, and paper, for unless this is followed up by personal attention to the purchaser, and the sitting on his doorstep for a while, they won't get the order.

## ENGINEERING NOTES FROM SOUTH AFRICA.

*(From our own Correspondent.)*

THAT "it is an ill wind which blows no one good" is illustrated in the effect of the South Wales colliers' strike upon the coal industry of Natal. Since the rise in the price of Welsh coal caused by the stoppage of work the coaling of vessels at Durban has enormously increased. Orders have been received from the Cape squadron at Simon's Town, and it has even been proposed to make Durban an Imperial coaling station. Something like a thousand tons of coal are now being sent away daily from the Natal port, and it is proposed to put up proper shoots at the wharves to expedite the coaling process and allow of a greater quantity being handled. Considerable orders for coal trucks have also been placed in England by the Railway Department. This "boom" in the coal industry has naturally directed a good deal of attention to the improvement of the waterway into Durban. Parliament has decided to proceed with the engineering works proposed by Sir C. Hartley and Sir J. Wolfe Barry, in spite of the vigorous opposition of those who maintained that dredging alone would suffice to keep a clear channel over the bar. The House of Assembly has also adopted the proposed Customs Convention with the Cape and the Orange Free State. This will open up a large market at Natal's own door for her sugar, coal, and tea, and should thus stimulate the Colony's production of those three commodities. On the other hand, it imposes heavy duties on over-sea food, and thus will stop the employment of capital for the purchase of refrigerating machinery for Australian mutton, &c.

The grievances of mine engineers in the Transvaal against the Government are many and various. One important part of the work of mining in the Republic is the construction of huge dams to create a reserve of water during the dry season. Cement has to be used for the walls of these structures. There is a cement "concession" in existence in the Republic, and for the protection of the factory which has been erected under it the Volksraad has imposed a duty of 12s. per ton on imported cement. Engineers do not care to trust themselves to the local material, and have to buy English or German cement, which, owing to the duty, costs 10s. per ton more than the stuff produced at the local factory. Some 75,000 tons of cement are used in the Republic annually, and of this total 50,000 tons are imported. The Volksraad has been discussing the matter this week, and has decided not to remove the tax.

It has been decided to build a new graving dock at Capetown, and Admiral Rawson, who is laying down the command of the Cape Squadron, has promised to appeal most strongly to the Admiralty to construct a graving dock at Simon's Town, the headquarters of the squadron.

The efficiency of machine rock drills is still a very moot point amongst mining engineers here, and there is undoubtedly room for improvement both in the machines themselves and in the methods of employment. The following data, collected by the mine inspector for Krugersdorf, are therefore valuable. Taking results from various companies Mr. Munnik finds that the average work of a machine drill is 28ft. drilled per shift. It would take nine or ten Kaffirs to do this work by hand, and a comparison of cost works out considerably in favour of the drills. In practice, however, the drills are found to be very wasteful in narrow stopes, and, of course, the purchase price and depreciation have to be added to working cost, as well as the cost of renewing the air compressor which supplies power.

In confirmation of what has been said here previously as to the value of a proper ore-sorting system, it may be added that on one lode—Witwatersrand mine—the tonnage crushed last year was only 185,179 tons.

The most interesting engineering topic in South Africa continues to be the progress of deep-level gold mining on the Witwatersrand. So far the results achieved have been almost without exception satisfactory, and there is every reason to anticipate both the financial and technical success of the bold theories upon which these enterprises were initiated. The Robinson Deep report, which has just been presented to the shareholders, shows that in three years and seven months a shaft of 1806ft. was sunk and crushing commenced. This is an excellent engineering record, and the conditions of mining at this depth fully support Mr. Hays Hammond's theory that the temperature would be normal. At this—the greatest depth at which gold mining has ever been attempted in South Africa—the results obtained from a judicious sorting of South and Main Reef stuff are, it is said, promising. It will be quite possible, I am told, to crush ore from the latter source with the richer South Reef at a profit. The company's experience shows that machine drills cost 2s. 6d. per ton crushed more than hand drilling, besides involving deterioration in grade on account of the increased proportion of "fivas." It is only four years ago since the possibility of working a gold mine at 2000ft. from the surface, yet this company has developed 230,000 tons of ore, and claims to be within measurable distance of the dividend-paying stage. The importance which the deep levels possess for British machinists is shown in the fact that out of the share and debenture capital of this company of £700,000 it has spent £542,855 on machinery and plant. Two new winding engines, 24in. by 72in., ten new boilers of 200-horse power, two electric generator engines of 250 kilowatts, and an electric hoist, are among the principal installations of the past year on this property. The directors have also placed an order increasing the stamp battery from 60 to 120 stamps. I mention this company at some length because it is in the extension of the deep levels that machinists and engineers at home must look for the resumption of heavy buying orders from the Witwatersrand.

The Orange Free State Parliament is discussing the details of a big scheme of railway extension. It has been decided to re-lay the main line with heavy material, and much debate is going on as to the extent and system of new construction. An American syndicate has offered to construct five new lines upon the basis of a guaranteed 3½ per cent. interest. Other schemes propose the construction of single lines by private capitalists and of three of the lines by the Government itself.

With the view of developing the Middelburg coalfields in the Transvaal the railway rate for coal has been reduced to ½d. per ton per mile for long distances. In Durban the demand for coal, thanks to the South Wales strike, is still very brisk. For the first time in the port's history the mail steamers are now taking in the Natal fuel. This has led to the satisfied and eager allocation by Parliament of the money necessary to commence the north pier extension works.

## AMERICAN ENGINEERING NEWS.

*(From our own Correspondent.)*

*High pressures for locomotives.*—One of the most important reports presented at the annual meeting of the Master Mechanics' Association—equivalent to locomotive superintendents—was that on the use of steam pressures of about 200 lb. per square inch. While there has been much trouble with some of the earlier boilers carrying such pressures, as their construction was to some extent experimental, there seems to be no reason why boilers cannot be built to successfully carry such pressures. A material increase in weight must be expected, and there must be thicker plates and more substantial staying and riveting. This being done, however, it seems to be established that the repairs of a boiler properly designed for its service vary directly as the horse-power of work performed, irrespective of the pressure carried. As to the repairs of the machinery of the engine, it is difficult to find any evidence tending to show that any other parts are affected by the higher steam pressures than the slide valves, valve seats, valve gear, piston-rod packing, and valve stem packing. Rod packing of soft metal may be melted by the higher temperature of the steam, making harder metal necessary. Higher steam pressure means increased wear of the slide valves and their seats, and possibly of the link motion, due to the drag of the valves, even if as well balanced as the ordinary slide valves, and also to the difficulties of lubrication. Those who have used piston valves consider that they meet the requirements of high pressures better than other forms of steam valves. On one road the cost of running repairs for engines carrying 200 lb. pressure was 12 per cent. higher than for engines carrying 150 lb.; but as the former were the heavier engines, a comparison upon a ton-mile basis would show an advantage for these engines. On the whole it is concluded that higher pressures can be introduced without any considerable increase in the cost of repairs of boiler or engine.

*American contract prices.*—A few months ago I gave some items of cost of contract work, as being of interest in comparison with English prices for similar work, and another list of prices for work recently let by tender is given herewith:—

| | £ | s. | d. |
|---|---|---|---|
| Water pipe, cast iron, 12in., per ton of 2240 lb. | 4 | 2 | 11 |
| " " 4in. " " | 4 | 4 | 2 |
| " " 6in. " " | 3 | 6 | 5 |
| Water meters, ¾in., each | 2 | 0 | 0 |
| " 2in. | 8 | 0 | 0 |
| " 4in. | 32 | 0 | 0 |
| Paving blocks (large size, brick) per 1000 | 5 | 0 | 0 |
| " bricks, wire cut | 3 | 7 | 2 |
| " " re-pressed | 3 | 11 | 4 |
| Pavement, sheet asphalt, per square yard | 0 | 7 | 10 |
| " brick, per square yard | 0 | 6 | 5 |
| Bridge substructure, rock excav., per cubic yard | 0 | 2 | 0 |
| Bridge substructure, Portland cement concrete, per cubic yard | 1 | 2 | 0 |
| Bridge substructure, stone masonry, per cubic yard | 2 | 8 | 4 |
| Bridge superstructure, mild steel, per pound | 0 | 0 | 1¼ |
| " " cast steel " | 0 | 0 | 3 |
| " " cast iron " | 0 | 0 | 2¼ |
| " " phosphor bronze " | 0 | 0 | 10 |
| Foot pavement, artificial stone, per square foot | 0 | 0 | 8¾ |
| Sewer materials:—Stone per cubic yard | 0 | 6 | 8 |
| " Bricks (hand-made) per 1000 | 1 | 6 | 5 |
| " Bricks (machine) per 1000 | 1 | 4 | 0 |
| " Bricks (vitrified) per 1000 | 3 | 10 | 4 |
| " Sand, per cubic yard | 0 | 2 | 8 |
| " Cement, natural, per barrel | 0 | 4 | 7 |
| " Cement, Portland " | 0 | 9 | 2 |
| Laying sin. sewer pipe, per foot | 0 | 0 | 2½ |
| " 12in. " " | 0 | 0 | 6 |
| " 20in. " " | 0 | 0 | 10 |

*Immense boiler plates.*—In some new goods engines of the C. C. C. and St. Louis Railway the rear sheet of the boiler will be in one piece, with longitudinal joints only at the bottom, where it connects with the base ring of the fire-box. These plates were rolled by the Illinois Steel Company and are 124in. wide, 220in. long on one edge, and 237in. on the other. The size before shearing was 130½in. by 375in. The thickness was specified to be $\frac{7}{16}$in., and the gauge showed from 0·577in. at the corners to 0·640in. at the ends near the middle. Each plate was rolled from an ingot 18in. by 40in., weighing 87001b.; and as the finished plate weighed 4960 lb., it will be seen that about 50 per cent. of the ingot was cut off. The ingots were made from a special melt of steel, and were rolled in a three-high Lauth mill with rolls 11ft. long, the top and bottom rolls being 36in. diameter, and the middle roll 22in. diameter. The mill is driven by an engine of 3000-horse power, with cylinders 54in. by 66in. One of the greatest difficulties in rolling such plates is to maintain the full width for 20ft. or 30ft. The furnace analysis showed that the steel contained 0·20 per cent. carbon, 0·38 per cent. manganese, 0·028 per cent. phosphorus, and 0·027 per cent. sulphur. Tensile tests of the plates showed an elastic limit of 37,690lb. to 44,760lb. per square inch; tensile strength, 58,810lb. to 62,930lb. per square inch; elongation in 8in., 26·50 and 26·75 per cent.; reduction in area at point of fracture, 62·83 and 56·27 per cent. The object of using a single plate for the shell of the fire-box is to avoid the side seams. At these seams the staybolts have to pass through the welt strips, and are more liable to break here than in the single plate. By eliminating the joint also a thinner plate is required, the saving in weight amounting to about 1000lb. in each engine.

*Telephone switchboard.*—The Western Telephone Construction Company has put in a large multiple-transfer switchboard for the Newark Telephone Company, a special feature of which is that it obviates the necessity of using multiple jacks, as it is found that on a switchboard of more than 1000 lines capacity these jacks became self-interfering, while the great number of interconnections becomes troublesome. Another feature is that coloured lamps are used to signal the operator automatically. Each signal is composed of a three-candle power miniature incandescent lamp, mounted in a tube, the front of which is closed by a prismatic lens of coloured glass. The circuits through these lamps are controlled by relays placed in any convenient position. The relays are in turn controlled by circuit-closers and circuit-breakers in the plug seats on the answering and transfer plugs. These parts are so connected with the circuit as to bring about the following results:—When a connection has been established by means of the insertion of a certain answering plug into the jack of the calling subscriber, and a certain transfer plug at another board into the jack of the called subscriber, and the clearing-out signal is given by one or both of the subscribers so connected, the clearing-out drop will fall, showing the operator at whose board the connection originated that a disconnection is desired. That operator will then withdraw the answering plug and replace it in its socket. The circuit-closer in the plug seat corresponding will by this action close the circuit through the battery and its corresponding relay, and thus throw the current upon two of the signal lamps, one at the board where the transfer plug is still in the jack of the called subscriber. The lighting of the lamp at the board at which the transfer plug is situated will show that operator that a disconnection is desired on the trunk line; while the lighting of the lamp at the first board will show the answering operator that a disconnection at the other board has not yet been made. Both lamps will remain lighted until the operator at the second board replaces the transfer plug in its socket, which will open the circuit-breaker in corresponding plug seat, thus breaking the circuit through both of the lamps.

DEATH OF MR. G. W. ELLIOTT.—With the death of Mr. G. W. Elliott, which occurred in Vienna on Friday last, the mining world has lost one of its foremost engineers, and one who has done as much to alleviate the labour in coal mines as any other man of the century. The inventor of many of the appliances for getting coal, his name has been associated with the Hardy Patent Pick Company, Limited, of Sheffield, for the past seventeen years, during which time the deceased gentleman has introduced some most valuable improvements in mining machinery, boring machines, and disintegrators. Associated as he has been with coal mining for a great number of years, his success as an inventor has been due to his ability not only to see a requirement, but to actually and practically demonstrate the power of mechanism to satisfy it. His name is equally well known abroad as in England, and his death will be equally felt by continental and English mining engineers.

## THE IRON, COAL, AND GENERAL TRADES OF BIRMINGHAM, WOLVERHAMPTON, AND OTHER DISTRICTS.

*(From our own Correspondent.)*

THERE was a large attendance from all parts of the country at the quarterly meeting of the Midland iron trade at Birmingham this—Thursday—afternoon, and the market presented a very satisfactory appearance, prices being on the upward grade in all departments, and prospects being declared decidedly healthy. This is an unusual state of affairs for midsummer, when the customary position of trade is one of quietude; but it is accounted for largely by the upward tendency of coal, as affected by miners' wages. The raising of the standard of coal values is having a decidedly stiffening effect upon the pig iron market, and the result is that the finished iron manufacturers are loud in their complaints as to the cost of raw material, which they declare to be out of all proportion to the prices recently obtainable for finished products.

The situation this afternoon was much the same as a couple of years ago, when the market was recovering from previous depression. The present revival was the subject this afternoon of satisfactory comment by pig iron sellers, and some good orders were booked; whilst the manufactured iron and steel firms also benefited, since consumers were anxious to place orders in face of the rising market.

Marked bars were re-declared on the £7 10s. basis at which they have stood since December, 1896. In the unmarked bar market there is still noticeable a good deal of variety in the prices asked, notwithstanding the existence of the association. Common bars are understood to be £6 to £6 5s., and merchant sorts £6 10s. to £6 12s. 6d., and on to £6 15s. for best qualities. At the April quarterly meeting common bars were quoted £5 12s. 6d. to £6, and a year ago they were being offered at £5 12s. 6d. to £5 17s. 6d. Common bars would therefore appear to be about 7s. 6d. better than twelve months ago.

At 3.15 this—Thursday—afternoon, the Unmarked Bar Association posted a notice on 'Change declaring that the basis price of unmarked bars, until further notice, would be £6 5s. per ton.

The prevalent progressive tendency was decidedly noticeable in the galvanised iron trade. Nothing less than £10 would be accepted by the galvanised iron manufacturers this afternoon for 24 gauge f.o.b. in bundles delivered Liverpool, which is an improvement of about 5s. on the quarter, for three months ago they were being quoted £9 15s. Twelve months ago the galvanised sheet minimum was as low as £9 5s., so that present prices represent an improvement of 15s. upon that length of time back.

Satisfaction is expressed that the quantity of galvanised sheets exported from Great Britain to all markets has risen from 111,555 tons during the first half of 1897 to 114,220 tons in the first half of 1898. The chief increase was to India, from 20,608 to 22,165 tons, whilst there was also an improvement in the case of South Africa, from 15,363 tons to 17,004 tons. The requirements of the Argentine Republic were also more pronounced, the exports to this market having risen from 7914 tons to 13,088 tons.

Rather more success than recently is attending the efforts made by the plain block sheet makers to improve values. To-day's average for doubles was £6 12s. 6d., and in some cases £6 15s. was asked, makers declaring that the recent level of £6 10s. was sadly too low, considering the cost of fuel and pig iron. At the April quarterly meetings the quotation was £6 2s. 6d. to £6 5s., and these figures were about the same as those that were quoted at the July quarterly meetings of 1897, so that both on the quarter and the year to-day's figures were an improvement of about 7s. 6d. per ton. Hoops were £6 7s. 6d. to £6 10s.; £5 17s. 6d. was quoted firmly as their minimum price by the tube strip makers, this being the figure to which it had been raised a week previously by an advance of 2s. 6d. Nor does it seem likely that this rise will prejudicially affect the demand.

There were plenty of orders to be given out for pig iron, but sellers seemed by no means over anxious to book. Producers are continuing their policy of keeping the output limited, and of getting as high prices as possible. Staffordshire all mine hot-blast pigs were quoted this afternoon 52s. 6d. to 55s., and part mine 45s. to 48s.; whilst the Association rate of £4 10s. per ton was firmly upheld by the cold-blast producers. Northampton forge sellers ask 46s. to 46s. 6d., and for Derbyshire 47s. to 48s. was demanded, whilst North Staffordshire sorts changed hands at 46s. to 47s. 6d. Speaking generally, to-day's prices are from 2s. 6d. to 3s. 6d.—and in some cases more—above the figures which were asked at the April quarterly meetings three months ago. The prices offered on that occasion were 40s. for Staffordshire cinder, 44s. to 45s. for part mine, 50s. to 55s. for ordinary all mine, and 64s. 6d. to 67s. 6d. for best ditto, whilst Northamptonshire forge was 42s. to 43s., North Staffordshire 44s. to 45s., and Derbyshire 45s. to 46s. This afternoon's quotations are also a considerable rise upon those of twelve months ago, to the extent, indeed, of 3s. 6d., and in some cases as much as 4s. A year ago Staffordshire all mine foundry was 60s. to 65s.; part mine, 47s. 6d. to 52s. 6d.; and cinder foundry, 40s. to 41s. 6d.; whilst as to forge qualities, cinder pig was 38s. to 39s.; part mine, 45s. to 47s. 6d.; and all mine, 55s. to 60s. Derbyshire best foundry was twelve months ago 50s. upwards, Northamptonshire forge was 43s., and Derbyshire 44s.

The number of furnaces in blast in South Staffordshire at the present time, namely, twenty-five in blast out of sixty-two built, is the same as three months ago, whilst only two additional furnaces have been blown in since January.

## NOTES FROM LANCASHIRE.

*(From our own Correspondents.)*

*Manchester.*—The only section of either the iron or the steel trades that still lags behind, and in which prices are not moving upward as was anticipated a short time back, is in pig iron, and the very general opinion expressed on 'Change here is that what would be really a legitimate advance is being checked by speculative operators, whose policy at present would seem to be to keep down the prices of warrants. In finished iron, bars are decidedly hardening up, and it is expected that this movement will, as soon as buying in raw material again sets in, bring pig iron up also. All through the steel trade there is a general strong stiffening up in prices, and in the engineering branches of industry, as I have previously intimated, new work is for the most part only being booked at higher prices than engineering firms were previously content to accept.

Perhaps as regards the engineering trades the most satisfactory feature to notice is that, with the great pressure of work just now prevailing throughout nearly all branches, amicable relations are being maintained between the workmen and the employers, the reports from all the principal firms being that operatives are going on without any of the friction usually experienced during periods of exceptional activity; and the conditions of labour laid down at the recent settlement are, with very few exceptions, being very loyally complied with. In fact, the opinion generally expressed by employers is that but for the recent struggle and the terms of settlement the position at present would not have been anything like so peaceable, and that a number of small matters of detail which have arisen, but have been mutually settled without much difficulty, would otherwise probably have developed into serious matters of dispute.

Generally on Tuesday's Manchester Iron Exchange reports were very satisfactory as regards business. Although in pig iron, buying was, if anything, only slow, representatives of makers in most cases reported rather more inquiries stirring, and in forge qualities some moderately large transactions have been put through at the minimum prices that makers are just now quoting. The principal sales have been in Lincolnshire, on the basis of 43s. 6d., delivered

Manchester, and 44s. 2d. net, Warrington. Local makers have also recently booked pretty well in forge numbers, for which they quote equal to 46s. 6d. Warrington, and 47s. 6d. Manchester, less 2½. Foundry qualities are about as reported recently, business in these being only moderate, with quotations unchanged; but makers of Lancashire, and also of Lincolnshire and Derbyshire, especially the latter, are so heavily sold that they have not much to offer, and are not at all eager about booking new orders at present. Outside brands offering here are about steady at recent quotations, and American pig iron is quoted at about late rates, with not much business doing.

Finished iron makers are in a strong position as regards bars, in which they are all well sold, and the basis price for Lancashire qualities has been advanced 2s. 6d. per ton, which it is expected will be followed by an advance of 2s. 6d. or 5s. for North Staffordshire bars with the close of the present week. The minimum quotations for Lancashire bars are now £5 17s. 6d. to £6, and for Staffordshire £6 to £6 2s. 6d., delivered in this district. Other descriptions of finished iron are unchanged, sheets averaging £6 17s. 6d. to £7 2s. 6d., and hoops £6 10s. for random, to £6 15s. for special cut lengths, delivered Manchester district.

In the steel trade activity in all branches, with a continued strong upward move in prices, is the general report. Hematites continue to harden, and No. 3 foundry qualities are not now quoted under 59s. 6d. to 60s., less 2½, with 1s. to 1s. 6d. per ton more asked for some special brands. Local billets are firm at £4 10s. net; in bars there is a very wide margin of quotations, according to quality, ranging from £6 2s. 6d. for some local makes, to £6 12s. 6d. and £6 15s. for special brands. Common steel plates are readily fetching £6 10s., which is the price some merchants have been taking, with the general quotation not under £6 12s. 6d., and boiler plates £7, delivered in this district.

This week I had an opportunity of going over the new works that have been erected on the most modern lines, adjoining the Belle Vue Station of the Great Central and Midland Railway companies, by Messrs. Kendall and Gent, the well-known machine tool makers, of Manchester. A special feature of these works is that they have been laid down to be driven throughout by electric motors, the lighting of the shops being also by electricity, and as probably electrical driving has not been carried out on so complete a scale at any other engineering works in the kingdom, a short description of their general arrangement, which also present other noteworthy features, will be of interest.

The works have a handsome frontage to the railway, and are exceedingly well equipped with executive and commercial offices, technical departments, and commodious and well-lighted drawing-offices. The main building is a large erecting shop divided into four bays 280ft. long, and each about 40ft. in width, lofty, and well lighted from the roof and sides. This shop is practically divided into two sections, for light work on one side and heavy work on the other, with the principal tools in the two central bays, which are traversed from end to end by electric three-motor travelling cranes, while each bay is served respectively by lighter tools suitable for the special work in the two outside bays. The arrangement of the various tools is carefully carried out on the rotation system, so that the work has not to pass over the same ground twice; and the shop, by means of a special siding, which brings the trucks inside the building and underneath the travelling cranes, which serve the two central bays, is in direct connection with the main railway line. In addition to the general plant on the ground floor, a couple of galleries carried over the side bays serve as convenient and extensive shops for light tools.

In laying out the electrical power for driving the whole of this shop what is known as the group system has been adopted. The central generating station, which is outside the shop, consists of an installation of two independent dynamos developing 200-horse power, which can be used separately for lighting or driving or for both, and in combination, as necessities may arise. The motors for driving the different groups of machines are mainly 20-horse power, but for lighter work they run as low as 10-horse power and 5-horse power, whilst the cranes are on the three-motor system throughout. As it is a matter of great importance in engineering work that the power required to drive each of the machine tools should be carefully ascertained in the introduction of electric driving, Messrs. Kendall and Gent have attached to each motor an ammeter, from which records are being carefully taken, so that very interesting data are being obtained in every department. Outside the main shop are lofty, well-lighted buildings, for the smithy and pattern shops, with the plant all electrically-driven, and also large pattern stores. I may add that the works occupy a very central position in the immediate neighbourhood of Manchester, in one of the most important engineering districts of Lancashire, the large engineering establishments of Sir Wm. Armstrong, Whitworth, and Co., and Beyer, Peacock, and Co., the carriage works of the Great Central Railway Company, Messrs. Crossley Brothers' gas engine works, and a number of other well-known firms, being in very close proximity.

An active inquiry is reported for all descriptions of fuel suitable for ironmaking, steam, and general manufacturing purposes, the demand being in many cases more than sufficient to take away all the present output of the collieries. The only quietude at all is in the better qualities suitable for house-fire purposes, which necessarily at this season of the year hang upon the market owing to absence of requirements for house-fire consumption; but although stocks are accumulating in the best qualities of round coal, and many of the house-fire pits are having to go on short time, prices are being steadily maintained at the recent full current quotations, any easing down, usually so prevalent during the summer months, being very exceptional, and confined to occasional special sales to clear off surplus lots. Common round coals for steam and forge purposes are not only in active request for inland requirements, but the shipping demand continues brisk, and collieries in many cases report orders coming forward in excess of their supplies. The result is that prices are exceedingly firm, with a tendency to harden, ordinary steam and forge coals being scarcely obtainable under 7s. for inland sales, at the pit mouth, whilst for shipment good qualities of steam coal are fetching 8s. 6d. to 9s., with, in some special cases, 9s. to 9s. 3d. still quoted. With the lessened demand for house coal, the output of slack is not quite so plentiful at the Lancashire collieries, and some of them are, if anything rather short of supplies for their regular customers, but there does not appear to be any scarcity in some of the outside districts, so that consumers have no difficulty in covering their requirements in the open market. Here and there a hardening up in prices for slack at the Lancashire collieries is spoken of, but so far there has been no really quotable change upon late rates, averaging 3s. 3d. to 3s. 6d. for common; 3s. 9d. to 4s. 3d. for medium, and 4s. 6d. to 5s. for best qualities at the pit mouth.

With regard to contracts the position is much as reported recently, colliery proprietors holding out for advances over last year's rates, partly to cover the increased cost as a result of the Compensation Act, and partly to meet the prospective advance in wages. In many cases 2d. per ton is being put on the contracts on account of the Compensation Act, and 3d. to 6d. to cover advances in wages, or where this is not being done, contracts are being governed by a sliding-scale arrangement, representing an advance of 3d. to 5d. per ton, according to quality, for every 5 per cent. advance in wages. The advances on contracts so far generally represent 3d. to 5d. on engine fuel, and 6d. up to 9d. on round coal, over the prices that were being got this time last year.

The Lancashire Coalowners' Association has been the first of the districts comprised in the Coalowners' Federation that has been called upon to decide as to the advisability of confirming the agreement with regard to a settlement of the wages question which was come to at the conference between representatives of the federated coalowners and the Miners' Federation, held last week in London, and their unanimous acceptance of these terms—which provide that the present rate of wages shall be increased as from October 1st, 1898, by 2½ per cent. on the standard, to remain at that rate until January 1st, 1899, and that for a period of two years from the last-named date, the rate of wages shall be determined by a conciliation board on the lines of that formed under the Rosebery agreement, with the condition that the rate shall not be below 30 per cent. nor more than 45 per cent. above the rate of 1888—may be taken as indicating that they will be similarly adopted throughout other districts of the Coalowners' Federation. It will therefore remain only with the miners as to whether what is generally regarded as a very reasonable and satisfactory basis of settlement shall be officially adopted on both sides, which would for two and a-half years ensure a period of peace in the coal trade similar to that which has apparently been secured throughout the engineering industries.

## THE SHEFFIELD DISTRICT.

*(From our own Correspondent.)*

THE business done by Yorkshire collieries with Hull during June shows a marked advance upon that for the corresponding month of 1897. The weight taken to the great Yorkshire port last month was 314,448 tons, as compared with 229,366 tons in June, 1897, showing an increase of 36·9 per cent. For the six months the weight was 1,464,240 tons, as compared with 1,179,088 tons in the corresponding period of last year, showing on the completed half-year an increase at the rate of 24 per cent. To foreign countries was sent last month a weight of 165,375 tons, which is an increase of 25·5 per cent. The half-year's figures exhibit a total of 615,694 tons, being an advance equal to 35 per cent. These advances, though remarkable, have another side to them in the weight of coal sent to the port last month, which, abnormal as it appears, was 10,500 tons less than what was sent in May, the exports to foreign countries being also lower by 28,000 tons. Of course, the heavy trade is due not to any exceptional improvement in the demand, but to the fact that foreign markets are drawing from Yorkshire supplies they formerly took from South Wales. Thus South America increased its demand from 6641 tons in June of last year to 33,895 tons for last month. The East Indies took 2489 tons, Egypt 14,801 tons, Gibraltar 556 tons, Malta 4041 tons, Portugal 840 tons last month. All these markets are usually supplied from the Welsh coalfield, and, with the exception of South America, they did not receive any Yorkshire coal at all in June of 1897. When the South Wales strike comes to an end there will be an immediate shrinkage in the Yorkshire export trade.

The chief feature in the coal trade of South Yorkshire during the last fortnight has been the setting down of about half a dozen collieries with an output of some 46,000 tons per week. It has not, however, had any effect upon prices, its only influence being to send the usual buyers to other collieries. The difficulty with the pit lads has been followed by a demand from the top men for an advance of 10 per cent. in wages. House coal is in rather better request than usual at this time of the year, the requirements of London having been largely increased owing to the diminished supplies from South Wales. Pit values remain pretty much as last reported. Best Silkstones are at 9s. to 9s. 6d. per ton; ordinary, from 7s. 6d. per ton; Barnsley house, from 8s. to 8s. 6d. per ton; seconds, from 7s. per ton. Steam coal of all qualities continues to be actively called for, and in several instances the stoppage of local collieries has interfered with short contracts. Barnsley bards fetch 8s. to 8s. 6d. per ton; seconds, from 7s. per ton. More money is being made on gas coal, advances of 6d. to 9d. per ton on last season's rates being realised. For engine fuel Lancashire remains a more important customer than usual, and the demand being generally steady, full values are easily maintained. Nuts, 6s. 6d. to 7s. per ton; screened slack, from 5s. per ton; pit slack, from 2s. 6d. per ton. Coke, which is in heavy request, is quoted at 9s. to 10s. per ton. in ordinary qualities, and in best coke 11s. to 12s. per ton.

The brisk trade reported last week in military, marine, and railway material is fully maintained, and there is abundant work in hand to keep the leading firms actively employed for several months ahead. Good orders are coming in from the shipbuilding yards, and colliery plant and stores are also in increased request. The railway material now being booked includes good orders from India and other colonial markets, while the home and the foreign countries are also placing considerable work with local firms. In the iron trade prices remain firm, and may now be quoted as follows:—West coast hematites, 60s. to 62s. per ton; East Coast ditto, 59s. 6d. to 60s.; Lincolnshire No. 3 foundry, 46s. to 46s. 6d.; forge ditto, 43s. 6d. to 44s.; Derbyshire No. 3 foundry, 47s. to 47s. 6d.; forge ditto, 43s. to 43s. 6d.; bars, £5 12s. 6d. to £6; sheets, £7 to £7 10s. In finished iron manufacturers are exceedingly well employed, although in the sheet trade affairs are not quite so brisk, and generally business is in a satisfactory state, with promise of increased activity as the year advances.

The foreign trade in cutlery for the month ending 30th June last shows an aggregate value of £47,656, and for the six months of £250,866. The principal colonial market has been Australasia, to which a value of £11,875 was sent on the month, and £51,287 for the six months. In hardware the exports for the month reached a value of £119,970, against £173,796 for June of 1897. For the six months the value was £712,230, against £1,067,680 in the first half-year of 1897. It is noteworthy that in hardware the United States trade has almost entirely disappeared, the value sent last month having been only £844 against £18,350. Comparison in the case of cutlery is not possible, as the Board of Trade has only recently begun to set out the colliery figures in a separate form. In steel unwrought the value for the month was £207,288, against £189,505. A significant increase is reported with Germany, which has advanced its trade from £29,308 to £42,741. This entirely bears out what has been repeatedly stated in THE ENGINEER, that the German manufacturers are putting, in a larger degree than they ever did before, the best Sheffield steel into their productions.

## NORTH OF ENGLAND.

*(From our own Correspondent.)*

THE iron market is steadily assuming a satisfactory condition, the tone is becoming more favourable for sellers, and business is larger in extent than it has been for at least two months past. That it is not larger still is due to the makers themselves, for consumers are ready enough to buy for forward delivery. But producers having plenty of orders on hand to take up nearly the whole of their output during the next four weeks at least, are indifferent for the present about selling further ahead, as they are of opinion that they will do better by waiting. It is usual to find a substantial improvement in the demand and prices about the end of July or the early part of August, and this year that is likely to be more pronounced, because the buying on foreign account has of late been less than usual. The prospects of a very brisk autumn trade are good, and there is reason to believe that the worst is over of the slackness that generally is experienced about the middle of the year. The price this week for prompt f.o.b. deliveries of No. 3 Cleveland G.M.B. pig iron has been 40s. 6d. per ton, both makers and merchants quoting this, and very few—certainly no makers—would sell at less. Odd lots have been disposed of at 40s. 4½d., but that would not be taken now. Some makers refuse to entertain any offer under 41s. per ton for their brands, and they could sell very little for early delivery at that. Various makers have been quoting 40s. 9d. for delivery up to the end of the current quarter, and buyers have been ready enough to give 40s. 6d., but were unable to find sellers at that. No. 4 Cleveland foundry iron is firm at 39s. 6d., and grey forge at 38s. 6d., while mottled and white range between 38s. and 38s. 3d.

Mixed numbers of East Coast hematite pig iron are fully 51s. 6d. per ton, and the prospects are that the price will be higher, because not only is there an improving demand, but the cost of production is increasing also, as both ore and coke are becoming dearer. The supply of Spanish ore is good yet, but it cannot be estimated how long it will continue so if the war continues and the Americans carry out their threatened operations on the Spanish Coast. The Spanish export duty on iron ore which has come into force, and is 25 centimes per 1000 kilos., will also tend to increase the price of the ore, besides which the rates of freight are rising. Merchants will not now sell even for prompt delivery under 14s. 3d. per ton, delivered Tees or Tyne, and they will not commit themselves for deliveries further ahead than about two months. Imports of foreign ore into the Tees during the past quarter exceed those of the previous three months by about 20 per cent., and consumers have heavy stocks.

Exports of pig iron from the Cleveland district show badly this month, but that is the general rule in July—its figures are always the worst in the summer half-year. The average monthly export is over 100,000 tons, but never in the history of the trade has July shown as much as that. It is midway between the spring and autumn shipping seasons, and is the time for the holidays in commercial circles on the Continent, besides which the lowness of the water in the rivers there prevents iron being sent cheaply into the interior. Next week's shipments are not likely to show any improvement, for the deliveries to Scotland also will be poor on account of the Glasgow Fair holidays, when most of the founders and other consumers of pig iron will have their establishments laid off. Already the deliveries from this district to Grangemouth have slackened considerably. The total shipments of pig iron from the Cleveland district have this month reached 38,010 tons, as compared with 48,049 tons last month and 42,253 tons in July last year, all to the 13th. The stock of Cleveland pig iron in Connal's public warrant stores on the 13th was 93,628 tons, an increase of 3553 tons for the month. The quantity of hematite held was 43,155 tons, a decrease of 1844 tons for the month.

At the Linthorpe Ironworks, Middlesbrough, Messrs. Edward Williams have blown in a furnace, and of their six furnaces four are now in operation, all producing hematite. Messrs. Bolckow, Vaughan, and Co. have blown out a furnace producing hematite iron at the Eston Steelworks, and one producing spiegeleisen at their Middlesbrough works; but of their twenty-four furnaces, seventeen are still in operation, twelve on ordinary Cleveland iron. Messrs. Wilsons, Pease, and Co., at the Tees Ironworks, have pulled down a furnace, but are about to commence the construction of another, and will also re-build their two large furnaces.

The return of the Middlesbrough Chamber of Commerce for the quarter ended June 30th shows that, out of eighty-six furnaces at that port, sixty-six are in operation, of which forty-four are producing ordinary Cleveland pig iron. The output for the last half-year has been 1,152,000 tons, against 1,092,000 tons in the first half of last year. The exports of pig iron from the port during the last half-year reached 506,370 tons, or 14 per cent. less than in the corresponding period of last year. The exports of manufactured iron and steel were still more unsatisfactory, as they were but 219,903 tons, this being 28 per cent. less than in the first half of last year.

The manufactured iron and steel industries are very active, and producers have no difficulty in getting as many orders as they can undertake. The tendency of prices is therefore upwards, and more especially is this the case with respect to iron and steel used by the shipbuilders. Steel ship plates are about £5 18s. 9d.; steel ship angles, £5 15s.; iron ship plates, £5 12s. 6d.; iron ship angles, £6 8s. 9d.; packing iron, £4 17s. 6d.; steel rivets, £8 7s. 6d.; iron rivets, £7 7s. 6d., all less 2½ per cent. f.o.t., and manufacturers are in no hurry to sell, especially as the outlook for shipbuilders continues so good. Common iron bars are sold at £5 7s. 6d., and best bars at £5 17s. 6d., both less 2½ per cent. f.o.t. The demand for steel rails is improving again; and as regards the work in hand there is no lack, so that £4 10s., net at works, for heavy steel rails is adhered to. Chainmakers are fairly well off, and £3 2s. 6d. is about their lowest price. Orders for bridge work are increasing, especially on Indian account, and pipefounders have good orders and good prospects, at that they are able to maintain their prices.

Shipbuilders are assured of full work for well into next year, and owners find considerable difficulty in placing orders where delivery within the next twelve months is required. The improvement in the engineering industry continues, and that prospects are encouraging is shown by the readiness with which employers have granted an increase of wages, though they have only given half of what the men claimed. The members of the Amalgamated Society of Engineers employed on the North-East Coast some time ago applied for an advance of 2s. per week on time rates and 5 per cent. on piecework prices, and the employers offered half of this, to commence from the first full pay in August. The men balloted on this offer, and on Tuesday it was announced that they had accepted it.

The Middlesbrough, Thornaby, and Stockton Electric Tramways were on Tuesday inspected by Major Sir Francis Marindin, of the Board of Trade Railway Department, and, being passed, will be opened for traffic to-morrow—Saturday. The stock extends from Norton to the railway crossing at North Ormesby, a length of 6½ miles; and also from the Royal Exchange, Middlesbrough, to Linthorpe, a distance of some two miles, and the greater part of the track being double, there is over twenty miles of track. The rails are of the steel girder type, weighing 92 lb. per yard, manufactured by the Leeds Steelworks, Limited. The weight used per mile of single track is thus 145 tons. The work was commenced in September last year, and is remarkable for the expedition with which it has been executed, besides which it is the largest length of electric tramway ever opened at one time. Some particulars of the undertaking have been drawn up by Mr. J. Clifton Robinson, the managing director and engineer. In the construction of the road bed the following concreting quantities were used:—Grey Cleveland slag, 5500 tons; best Portland cement, 3500 tons; sand and gravel, 12,000 tons. For the tramways 2700 tons of rails, points, crossings, fish-plates, bolts, and tie bars were used, while the copper bonding to the rail joints cost over £2000. The paving required 1,300,000 scoria paving blocks, 7500 tons of whinstone and granite blocks, and 75,000 tons of creosoted beech blocks. On these and other materials £20,000 was spent, in wages £15,000, in railway and carriage charges, £5000. The power house and other buildings cost £10,000, while the contracts for the steam and electrical plant, poles, and overhead lines represent a sum of £70,000. The entire cost of the system has so far been £200,000. The whole of the electrical plant and equipment has been supplied by the British Thomson-Houston Company, Limited, under the supervision of Mr. Horace F. Marshall. The power house is in Bridge-road, Stockton; the engine-room is 110ft. by 52ft., and has a clear space of 36ft. from the floor to the tie bars of the roof principals. The boiler-room is 28ft. by 48½ft., and is of the same height as the engine-room. There are provided three Babcock and Wilcox boilers, each having a heating surface of 3580 square feet, and capable of evaporating 12,000 lb. of water per hour. Each boiler has a Vickers mechanical stoker, worked by an electrical motor. The coal bunkers are of steel, supported by steel columns, and have a total capacity of 300 tons. The company has a wharf with a frontage of 200ft. to the river Tees, and upon this is an electric crane for discharging coal from the vessels. In the flue leading to the smokestack is a Green's economiser. The boilers supply steam to three Reynolds-Corliss horizontal compound condensing engines of 400-horse power each, made by the G. and P. Allis Company, Milwaukee, U.S.A. The high-pressure cylinder is 16in. diameter, and the low-pressure 32in., the stroke being 36in. Each engine runs at ninety-four revolutions per minute, and is directly coupled to a 300-kilowatt

three-phase generator. Over thirty cars, each to accommodate thirty persons inside and thirty out, and costing £800 each, have been put on the line. Sir Francis Marindin expressed himself as pleased with the satisfactory manner in which the work had been carried out. The power house was inspected and passed by Major F. Cardew, R.E., the electrical adviser of the Board of Trade.

The coal trade has shown a considerable increase in activity since the middle of last month: indeed, it may now be described as very brisk, more so, in fact, than it has been for several years, and though working their collieries to their fullest capacity, some of the coalowners are behind in the execution of their orders, which have been very pressing. The demand from the Baltic ports is extra good, besides which there is more demand from other quarters, a good deal of which is coming this way on account of the Welsh strike. The improved position and prospects have induced the Hetton Coal Company to decide upon the re-opening of the Elemore Colliery, which has been closed for five years, but has been kept in repair, so that there will be no delay in getting it to work again. Best steam coals are being sold at 13s. to 13s. 6d. per ton f.o.b., and smalls at 5s. 6d. to 5s. 9d., while gas coals are about 9s. f.o.b., house coal 10s. 6d. to 12s., and ordinary unscreened bunkers 8s. 6d. to 9s. 3d. all f.o.b. Tyne. Even the house coal pits are in full operation, which is rather unusual at this time of the year. The average price of blast furnace coke is 14s. 3d. per ton delivered equal to Middlesbrough, and that shows an improvement on last week.

## NOTES FROM SCOTLAND.

(*From our own Correspondent.*)

THE market for iron and steel has been very quiet this week, in consequence of the Glasgow Fair holidays, which have now begun, and will extend over the whole of next week. In the warrant market there has been unusually little doing, and the market was closed on Thursday at mid-day until Tuesday of next week. Both home users and shippers are doing very little, and it is likely that business will be quiet for the next fortnight at least.

Scotch pig iron warrants sold in small quantity at 45s. 11d. and 46s. cash, and 46s. 1d. to 46s. 2d. cash. Business was very dull in Cleveland warrants at 40s. 3d. and 40s. 2½d. cash, and 40s. 6d. to 40s. 4½d. one month. Cumberland hematite warrants have sold slowly at 50s. 9d. and 50s. 9½d. cash, and 51s. to 50s. 11½d. one month.

There are 81 furnaces in blast, compared with 77 at this time last year, and of the total 43 are producing hematite, 32 ordinary, and six basic iron.

Merchants quote Scotch-made hematite 54s. per ton, delivered in railway trucks at the steelworks, but the demand at present is comparatively small.

The prices of Scotch makers' pig iron are steady. Govan and Monkland, f.o.b. at Glasgow, Nos. 1 are quoted 46s. 7½d.; Nos. 3, 46s. 1½d.; Wishaw and Carnbroe, Nos. 1, 46s. 9d.; Nos. 3, 46s. 3d.; Clyde, No. 1, 51s.; No. 3, 47s. 6d.; Gartsherrie and Calder, Nos. 1, 51s. 6d.; Nos. 3, 47s. 6d.; Summerlee, No. 1, 52s.; No. 3, 47s. 6d.; Coltness, No. 1, 55s.; No. 3, 48s.; Glengarnock at Ardrossan, No. 1, 51s. 3d.; No. 3, 46s. 3d.; Eglinton at Ardrossan or Troon, and Dalmellington at Ayr, Nos. 1, 47s. 9d.; Nos. 3, 46s.; Shotts at Leith, No. 1, 52s. 6d., No. 3, 48s. 6d.; Carron, at Grangemouth, No. 1, 52s.; No. 3, 48s. 6d.

The shipments of pig iron from Scottish ports in the past week amounted to 4127 tons, compared with 4769 in the corresponding week of last year. Of the total there was despatched to South America 55 tons, Australia 167, Italy 575, Germany 450, Russia 185, Holland 120, Belgium five, other countries 215, the coastwise shipments being 2265 against 1978 in the same week of 1897.

The manufacturing iron and steel works are now closed, but they have in most instances good contracts on hand, and will be able to resume on full time after the holidays.

The coal trade has been well employed. The shipments in the past week have again been large, amounting to 247,190 tons, against 253,719 in the preceding week, and 183,728 in the corresponding week of last year. Prices for shipment and home use are firm. A large quantity of coal has been purchased for the gasworks by the Corporations of Glasgow and Paisley, close on 600,000 tons, and the prices are reported to be from 1s. to 2s. per ton higher for splint coal than those paid at this time last year.

## WALES AND ADJOINING COUNTIES.

(*From our own Correspondent.*)

THE burst of really summer weather has begun to tell upon the bituminous coal trade generally, which so far has had an extended life, owing to the stoppage of so many collieries. One result of the strike has been to bring other coals to the front, and when a resumption of general work takes place, some of these may be expected to stay. I find that the Rhos Llantwit, an excellent coal, has been quoted freely in Cardiff for bunkering. This is worked through, and sells at 12s. 9d. Maesteg coal is selling freely, also Perche's Clydach and Glyncorrwg coals. Small steam is in particularly good demand at varying prices. Naval is selling at 12s., Llanbradach at 10s. 9d. to 11s. Cardiff Exchange small steam quotation is 11s. 9d. to 12s. Last week there was a fair shipment, but of late bookings for prompt shipment have been rather dull. On 'Change, Cardiff, this week, this was accounted for by the fact that colliery proprietors had previously disposed of by far the greater portion of their output, and buyers requiring coal for immediate shipment were, as a rule, compelled to go elsewhere for their supplies.

The Cardiff coal shipments last week scarcely totalled 90,000 tons. Swansea was 38,132 tons, and that of Newport, Mon., only amounted to 11,810 tons. Some of the Cardiff shipments will be of interest, as showing the drift of the trade. Genoa, 5500 tons; St. Paul de Loando, 3200 tons; Rivaens, 2900 tons; Tattal, 2500 tons; Rio, 2200 tons; St. Nazaire, 3460 tons; Alexandria, 2200 tons; Stockholm, 1300 tons; Bombay, 4000 tons.

Newport, Mon., sent away one good cargo to Aden, 5600 tons.

I am favoured with June statistics. These with the totals from April 1st do not make pleasant reading, though there is an improvement to be noted. For instance, the June shipments of coal from Cardiff came up to 331,761 tons. The April total was only 326,000 tons. In steel, coke, and patent fuel there is a falling off. April total, steel, was 9974 tons, coke 3500 tons, patent fuel 13,501 tons. June steel was 57 tons, coke 2182 tons, patent fuel 11,156 tons. One has only to hark back to January totals to see the tremendous collapse. Coal 1,708,892 tons, steel 5724 tons, coke 7630 tons, patent fuel 35,804 tons.

Newport coal total for June was 24,671 tons foreign, and 33,529 coastwise. Swansea 104,378 tons foreign, and 34,059 tons coastwise. In iron and steel Newport compares favourably:—2125 tons, and also in patent fuel, 8205 tons. Swansea exhibits a fair total iron and steel, 502 tons; a good total coke, 1023 tons; and a very good one in patent fuel, 43,128 tons. Llanelly, in June, sent 20,340 tons coal, as compared with 24,234 tons in January. Looked at collectively, a few figures yield a significant sermon. The total quantity coal despatched from all Welsh ports in June amounted to 548,728 tons, as against 1,577,295 tons shipped in June, 1897; over a million tons deficit.

It will be seen that prices are a shade weaker. Mid-week on 'Change, Cardiff, the closing prices were as follows:—Best steam coal, 20s. to 21s.; best Monmouthshire, 17s. to 18s.; drys, 15s. to 16s.; best steam, small, 11s. 6d. to 12s.; best house, 16s. to 17s.; No. 2 Rhonnda, 13s. 9d. to 14s. 3d. Swansea prices:—Anthracite, 12s. to 13s. 6d.; seconds, 11s. to 12s.; ordinary large, 10s. to 10s. 6d.; small rubbly culm, 5s. 6d. to 6s.; Swansea f.o.b. cash thirty days less 2½; steam and bituminous coals, coke, and patent fuel prices according to private arrangement during the strike.

In the Swansea Valley the whole of the collieries re-started work on Tuesday, and as the men worked with a good deal of energy to make up for lost time, a large output was the result. The fortnightly payment was made as usual at the Birchgrove Graigola pits, so there is no question now raised with the workmen as to the continuance, and no doubt entertained about their earnings. In connection with their application for an advance, this is not to be enforced. The workmen at Primrose Colliery, Pontardawe, and Cwrt y Bettws, Skewen, will terminate their fourteen days' notice on Saturday, and it remains to be seen, as hoped, whether some arrangement will be entered into or not.

Swansea maintains a large French coal trade. Last week shipments were 13,548 tons; to Holland, 1395 tons; to Russia, 1800 tons; to Italy, 2910 tons; to Newfoundland, 1028 tons; to San Francisco, 6080 tons; United States bunkers, 1994 tons.

Patent fuel is very active in Swansea. Last week shipments were over 12,000 tons. Principal consignments were to France, 3145 tons; to Russia, 3500 tons; to Italy, 1170 tons; to Tunis, 900 tons; Beyrout and Algeria, 1550 tons.

As showing the present time to be an unfavourable one for putting Welsh collieries into the market, I note that a few days ago the Garth Merthyr Steam Colliery was submitted to auction. The first bid was £110,000, and by small degrees this was advanced to £117,000, and was then withdrawn.

In Cardiff No. 2 Rhondda and manufacturing coals are in good demand. The patent fuel trade is brisk, prices 16s. to 17s. Coke is reported brisk; furnace, 18s. to 18s. 6d.; foundry, 20s. to 21s. Pitwood has been selling fairly well at 14s. 6d. to 14s. 9d., but tendency is downward, large consignments coming in. Freights from Bilbao home reported bad, and down to 4s. 9d. for Cardiff. Briton Ferry is more brisk than Cardiff with these freights. Very few consignments of iron ore came in to Newport or Cardiff last week. Two for Newport, Mon., totalled 3100 tons. Most of the ironworks are well stocked. Last quotations, Cardiff: Tafna, 13s. 3d. to 13s. 6d.; Rubio, 13s. 9d. Swansea figures: Tafna, 14s. 6d.; Rubio, 15s. ex ship Swansea 30 days.

On 'Change, Swansea, mid-week, it was stated that pig iron warrants had just maintained their position during the past week, showing from ½d. to 2d. per ton advance. It was regarded as probable that Spanish ore would go to higher figures, through a further increase in the duty placed by Spain. This may be expected to tell seriously. The works on the hills continue closed down, though employment is given to a large number of labourers and repairers. Quotations are scant: Glasgow pig iron warrants, 45s. 11½d. to 45s. 11d.; Middlesbrough No. 3, 40s. 3d.; other numbers in proportion. Hematite warrants, 50s. 3d. for mixed numbers. Siemens tin-plate bars, best, £4 10s. All Swansea. Bessemer steel coke plates, 10s. to 10s. 3d.; Siemens coke finish, 10s. 3d. to 10s. 6d.; ternes, per double box, 28 by 20 C., 18s. 6d., 19s. 6d., to 21s.; wasters, 6d. to 1s. less than primes. Block tin, £70 1s. to £71 2s. 6d. Lead: English, £13 3s. 9d.; Spanish, £13 1s. 3d. Copper: Chili bars, £50 5s. to £50 11s. 3d. The make of tin-plate in the Swansea district last week totalled 47,843 boxes; shipment, 33,515 boxes; present stock, 159,971 boxes.

The shipments of tin and black plates at Swansea last month totalled 10,249 tons, as compared with 11,577 tons June, 1897. The destinations this year were as follows:—To Russia 3606 tons, as against 5255; Denmark 898, as against 30; Holland 89, against 62; Germany 855, against 1302; France 1049, against 1720; Portugal 803, against 157; Italy 650, against 446; Austria 141, against 94; Greece 11, against nil; Straits Settlements 81, against nil; China 1234, against nil; Japan 67, against nil; United States 765, against 2511.

The labour outlook is better, and it is satisfactory to report a settlement of the strike at the three large works in the Llanelly district, the men having accepted the masters' terms. No further complication seems likely. The quotations given, it is understood, are scarcely realised, and the demand is anything but good. In some quarters I hear that it is difficult to get sufficient orders to keep the mills going. In many the complaint is heard of a scarcity of tin bar. Stocks are at a minimum. Last week, at Gilbertson Works, Pontardawe, the two large steel mills, constructed on an improved principle, similar to the huge matching mills of America, were started, and are doing well. A number of Upper Forest millmen have found employment there. The cogwheels of the Duffryn three-mill engine have been replaced, and two of the mills were started on Monday.

Considerable public interest has been displayed in the settlement at Morewood's works by the new syndicate. The principals include Mr. William Williams, late M.P. for the Swansea district, and it is expected that the works will be under the management of Mr. Frank Thomas, of Lydney. The belief is that they will be in full activity before the month is out. Of the three works in Llanelly that were stopped temporarily, two are now in steady drive, and the other daily expected.

The Neath, Pontardawe, and Brynmawr Railway Bill came on Tuesday before the Unopposed Committee of the House of Lords, and was ordered to be reported for third reading.

A committee of the Swansea Corporation having visited the Birmingham waterworks, Rhayader, and reported thereon, it was decided this week to proceed on similar lines at the Swansea works with regard to the cooking for the men, religious services, and education of the children as followed at the Rhayader township.

The South Wales Employers' Indemnity Society held their first meeting this week in Cardiff. There was a good attendance, and the secretary reported that twenty-one colliery companies had made formal application to join. The number of workmen at these collieries total 42,550, and this was regarded as a very satisfactory start. Intimation was also given that the memorandum and articles of association were under consideration by a very large number of colliery companies, but sufficient time had not yet been given for their decision. This was confidently expected to be favourable.

At Newport, Mon., this week it was reported that the water supply was unsatisfactory. They had sufficient for three months, but 60 million gallons less than last year. Satisfactory reports came to hand from the new works at Bentwood. Mr. Baldwin Latham, the engineer, reported that the aqueduct with iron pipes, provided for in the original plans, and which he estimated to cost £50,332, would be substituted by one constructed of brickwork, which would cost £37,420, and yield a million gallons of water more daily.

Lord Windsor has deposited a petition in the Private Bill-office of the House of Lords, praying to be heard by counsel against alterations in the Windsor Dock—Cardiff—Bill when it reaches the Select Committee stage.

A good deal of feeling has been aroused in the Llanelly district, consequent upon the rejection of the Llanelly and Pontardulais Railway Bill by the Lords Committee. It was thought that it would have done much in the development of the town and district, and strenuous efforts are to be made until it is won.

## NOTES FROM GERMANY.

(*From our own Correspondent.*)

ON the iron and steel market in Silesia both raw and manufactured material continue in active request, with prices generally inclined to tend upwards. Alterations of importance cannot, however, be reported to have taken place since former letters. Establishments in all branches of the engineering trade are briskly engaged, with orders on their books to carry them well over the next months.

The Rhenish-Westphalian iron industry presents a bright aspect. There is a good business done in pig iron, stocks showing a decrease. The blast furnace works of Luxemburg have reduced the export bounty from M. 6 on M. 3 p.t. on one-third of the quantity sold. Prices for pig iron show no variation. Blooms are getting rather scarce, but that is generally the case at this time of the year. The manufactured iron trades are very briskly engaged, and orders are so plentiful that the maintenance of the present state of activity at most of the mills may be expected to continue for a long time.

The plate and sheet trade is showing new life in all departments, and the girder mills are in a most excellent position as regards employment; dealers frequently have to grant six or eight weeks as term of delivery. But in spite of the increasing employment in the girder trade, prices still show very little inclination to move upwards. The wire business continues somewhat moderately engaged, although there is an undeniably better feeling shown generally. An extraordinarily good demand is reported in railway material, and the locomotive and wagon-building establishments all over the district are vigorously occupied, and will remain so for some time to come. Several heavy rail orders have quite recently been given out by the State Railways.

Demand and inquiry in the German coal trade increase from week to week. In Rheinland-Westphalia a rise of 0·50 p.t. for coke was resolved upon, which brings the price of coke on M. 8·50 p.t.

The movement in the prices of German coal during the past ten years is shown by the following:—In January, 1888, dry coal was sold at M. 5·10 p.t. on the Rhenish-Westphalian market; steam coal, M. 5·70 p.t.; and best steam coal, M. 5·80 p.t. Before the year ended all three sorts had risen M. 1 p.t., quotations being M. 6, M. 6·70, and M. 6·85 p.t. No alteration in price was then perceptible until the great strike came, in May, 1889. When, after the ending of the strike, prices for coal were again fixed, a rise of about 50 per cent. was perceptible, M. 9·25 and M. 10·30 p.t. being quoted for the above-named sorts. A steady upward movement in quotations for coal then began, until, in February, 1890, the maximum of M. 12·75, M. 13, and M. 14·75 was reached. For about three months these rates were well maintained, then a slowly decreasing tendency began to be experienced, until, on May 1st, 1893, the Rhenish-Westphalian Coal Convention was formed. At that period dry coal was sold at M. 7·50 p.t.; steam coal, M. 7·75 p.t.; and best steam coal, M. 8 p.t. Prices remained the same for about a year, then M. 8 p.t was quoted for steam coal and M. 9 p.t. for best steam; while dry coal continued to be quoted M. 7·50 p.t. for three years and eight months, viz., from January 1st, 1893, to September 1st, 1896. Then it advanced on M. 8 p.t., and in March, 1897, rose on M. 8·38 p.t., which is the present price. Steam coal rose on M. 8·63 and best steam coal on M. 8·63 p.t. at the end of 1897, and have during the present year met with very slight advances only.

The Austro-Hungarian iron market presents no interesting feature, nearly all departments being but indifferently engaged. Consumers and dealers, as a rule, simply buy to meet hand-to-mouth requirements. A normal trade is being done in structural iron, while sheets and axles remain neglected, and the business in tools, though perhaps a trifle better than before, is still only of a moderate description.

Consumers for iron and steel in France show much reserve, and the tone of the iron market is therefore comparatively languid. Merchant iron is quoted 155 to 160f. p.t. in Paris; girders fetch 170f. to 175f. p.t.

A brisk export trade has been transacted on the Belgian iron market during this week and the last, inland demand being regular, though not very active. The outlook generally is, however, regarded as ensuring a certain degree of briskness in almost all branches of the iron industry for a good time ahead.

Swedish export in iron and steel during the first five months of present year was, in raw and manufactured iron, plates, nails, &c., 80,137 t., against 80,989 t. for the corresponding period last year. Exports in iron ore were 230,098 t., against 249,299 t. in the year before, the falling off against last year being due to the fact that shipments of Gellivara ore in Lulea could not begin till in the middle of June.

The iron foundry that has been built in Trapezunt is stated to have produced last year 7700 kilos. castings, worth 25 to 32 kreutzer per kilo., and the six brass foundries produced 10,752 kilos. brass articles, worth between 0·91 to 1·35 gold florins per kilo. The brass foundries are doing a good trade, it appears, output last year showing an increase of 50 p.c. against the year before.

## THE NEWPORT HARBOUR COMMISSIONERS' WEEKLY TRADE REPORT.

EXPORTS for week ending July 9th were:—Coal: Foreign, 7350 tons; and coastwise, 4460 tons. Patent fuel: 2850 tons. Imports for week ending July 12th were:—Pig iron, 4380 tons; manganese, 300 tons; iron ore, 3450 tons; and 2 cargoes of flour.

Coal: No quotations. Pig iron: Scotch warrants, 45s. 11d.; hematite warrants, 50s. 10d., f.o.b. Cumberland; Middlesbrough No. 3, 40s. 3d. prompt. Iron ore: Rubio, 13s. 6d. to 13s. 9d.; Tafna, 13s. to 13s. 3d. Steel: Siemens steel tin-plate bars, £4 10s. All delivered in the district, cash. Tin-plates: Bessemer steel, coke, 9s. 9d.; Siemens, coke finish, 10s. Pitwood, 15s. 3d. to 15s. 6d. London Exchange Telegram: Copper, £50 6s. 3d.; Straits tin, £71 6s. 3d.

THE EXPLOSIVES ACT.—The twenty-second annual report of her Majesty's Inspectors of Explosives has just been issued as a parliamentary paper. The growth of the trade in explosives, which was referred to in the annual report for 1895, has in no sense relaxed during the past year. Although the number of factories—138—has decreased by one, three new ones have been added since 1896, while no less than ten applications for new licences are still under consideration. The number of deaths from accidents by fire or explosion in manufacture was nine. Although this is in excess of last year's number—which was only one—and greatly above the average for the decade—5·2—it is pointed out that it is still relatively inconsiderable, and presents a most satisfactory contrast with the figures which prevailed in the past. Of the nine deaths in the past year no less than six were due to a single accident. It is further remarked that the risks attending the manufacture of wholly new explosives, to which a large proportion of the new factories are applied, are less known than those connected with the more familiar explosives, and therefore are not so easy to provide against. The total number of accidents shows an increase—viz., 160 against 134, and is above the average—134·1—for the last ten years. The number of deaths from accidents shows an increase—viz., 45 against 33, and is slightly above the decennial average—36·5. The number of persons injured last year was 171, as against 111 in 1896, and is considerably above the average—118·4; 109 of the accidents causing death or personal injury occurred in the use of explosives and under miscellaneous conditions to which the controlling provisions of the Act do not apply. Such accidents caused 35 out of the 45 deaths, and 142 out of the 171 cases of injury. This leaves a balance of 51 accidents, causing ten deaths and injuring 29 persons in manufacture, storage, and transport, the conditions to which the Act applies. The result shows an increase—seven to ten—in the number of persons killed compared with the previous year, but the number of persons injured shows a decrease—31 to 29. During the year the first public inquiry was held since the passing of the Act into the question whether the appeal of a company, which had been refused a licence by the local authority, should be allowed. This was the appeal of the Schultze Gunpowder Company, Limited, against the County Council at Southampton, which resulted in favour of the appellants. The inspectors profess to be thoroughly satisfied with the "sound practical working of the system of licensing as laid down by the Explosives Act of 1375."

## AMERICAN NOTES.

*(From our own Correspondent.)*

NEW YORK, June 30th.

THERE is an abundance of money in financial circles, which does not extend to all avenues of business. The total volume of business for the half-year is in excess of the phenomenal year of 1892. Prices are lower, production heavier, margins less, but commercial risks are also less. The agriculture interests lead, and a heavy domestic and foreign demand is maintained. Latest estimates show the largest crops ever harvested. In the iron, steel, coal, and machinery lines, fair conditions prevail. Iron and steel have weakened, and brokers representing consumers have strongly advised that, if present quotations on furnace and mill products continue into July, to place contracts to cover their probable supplies into early winter. A few have already done so. Large offerings of iron are being made, as furnace men are unwilling to permit an accumulation and will not come down to banking a part of their capacity. Pennsylvania and Ohio furnaces are pretty well sold up, especially those on Bessemer and basic irons. The Western rolling mills are booking autumn business steadily, the policy being to secure raw material as fast as orders for finished products are received. Pipe and tube works are gathering in fair orders. Merchant steel orders this week were taken at full prices. This branch of the iron trade is full of promise because of the general activity in industries wherein steel is used. The machine tool works are particularly busy, and heavy machines, for rolling mills and all kinds of manufacturing plants, are now being contracted for. The demand for electrical equipments is again increasing, and all the well-established plants are paying good dividends. The one evil which American enterprise has to guard against at this time is that of over production. A higher view of self-interest in this regard now prevails, and organisation means more than it did a few years ago. Then, during the past three or four years there has been so much intercourse of manufacturers that the rough edges have worn off and much consolidation has taken place, and mutual understandings arrived at in other cases, that there is a prospect for more intelligent competition. Then the outlets in countries beyond the seas are diverting attention from home markets, and they serve as an escape valve to enterprise.

## THE MOTIVE POWER SUPPLIED BY THE RIVER ARC.

BELOW Modane the waters of the Arc are utilised for supplying motive power to several large industrial establishments. The first of these is at La Praz, 3¾ miles from Modane, the water being diverted by damming the stream about half-way down into a large reservoir to facilitate the deposition of the sand, which is brought down in such large quantity by the current that, even with this precaution, the turbines are worn out after six months' continuous work. A conduit 80in. in width, made of boiler plate 0·275in.—7 mm.—at the upper end and 0·39in.—10 mm.—at the lower end, and supported on pillars of masonry 80in. apart, conveys the water from the settling basin, a distance of 1640 yards, the fall being 115ft.—35 m.—and the delivery 1540 gallons—7 cubic metres—per second. There are a number of small turbines and three of 700-horse power each, the latter worked at a speed of 300 revolutions per minute and coupled direct on to vertical-shaft dynamos, two of which are of the 24-pole type, and the third a unipolar machine constructed by Siemens, and developing a 15,000-ampère 40-volt current. At present the output of the establishment is about one ton of aluminium per diem, and calcium carbide is also manufactured; but when the new conduit is completed another 10,000-horse power will be available—a grand total of 13,000-horse power This second conduit is in two lengths of 1640 yards. The upper one is tunnelled through the hill-side, the lower portion, which is 94½in. wide, being arranged like the one already described. The total fall from the intake to the turbines—twenty-five in number—is 246ft., which, with a delivery of 2640 gallons—12 cubic metres—per second, will produce 10,000-horse power.

About three miles lower down the river is a large electro-chemical works, and here the water is conveyed for over 1¼ mile through an underground channel to a height of 230ft. above the factory, being conducted to the turbines by two sheet-iron pipes about 330 yards long and 47in.—1·20 m.—in diameter, with a delivery of 1760 gallons per second. There are twelve 200-horse power turbines and four of 400-horse power each—a total of 4000-horse power—all fitted with removable crowns. Their speed is 300 revolutions per minute, and they are coupled direct to Thury dynamos, the smaller ones of the 6-pole type and producing a 200-volt 500-ampère current, whilst the larger ones are 12-polar and develop a current of 1000 ampères at 200 volts. In these works potassium chlorate, sodium chlorate, and calcium carbides are manufactured by the electrolytic process.

The third large establishment is the Calypso Aluminium Works, situated about three miles below St. Michel, and obtaining water from the Valoirette through a conduit 875 yards in length, partly underground, which discharges into two iron pipes, one with a diameter of 26½in.—60 cm. —and a capacity of 220 gallons per second, and the other 55in.—1·40 m.—in diameter. There are two 1250-horse power turbines making 140 revolutions per minute, coupled direct to 12-pole Weyher and Richemond dynamos, producing a 6000-ampère 150-volt current. An extension of the establishment is in contemplation, a new channel 3280 yards long, giving a fall of 1968ft., and discharging into two 31½in.—80 cm.—conduits, being projected, which will yield an additional 12,000-horse power.—*Inst. C.E. Abstracts.*

THE copper industry of Germany for the year 1897 shows an increase unparalleled in the trade statistics of the world. The import of raw copper from this country has decreased, and now North America is the chief market for the German supply.

## THE PATENT JOURNAL.

*Condensed from "The Illustrated Official Journal of Patents."*

### Application for Letters Patent.

*** When inventions have been "communicated" the name and address of the communicating party are printed in italics.

*1st July*, 1898.

14,546. BOBBINS, J. A. Sutcliffe and G. Paley, London.
14,547. SKIRT-SUPPORTING BELT, H. M. Knight, London.
14,548. ELECTRIC CONTACT MAKERS, E. W. Bowles, London.
14,549. PIPETTE, P. Weissgerber, London.
14,550. PIPE JOINTS, W. C. Humphrey, London.
14,551. SANITAS SMOKING MIXTURE, R. Auerbach, London.
14,552. IMPLEMENT for CLEANING DISHES, C. E. Challis, London.
14,553. ENGRAVING on STONE SURFACES, E. W. Smith, London.
14,554. REFRIGERATING APPARATUS, W. W. Harris, London.
14,555. WATERING-CANS, W. Hardy, Birmingham.
14,556. PREVENTING FRAUDULENT RE-FILLING of BOTTLES, C. J. Bishop, Liverpool.
14,557. TREATING OILS, J. Ashworth, Manchester.
14,558. WINDOW-SASH FASTENER, J. H. Smith, Birmingham.
14,559. UMBRELLAS, W. L. Milligan, Liverpool.
14,560. PRODUCING LITERATURE for the BLIND, J. G. Fisher and W. Littlewood, Manchester.
14,561. IMITATING HAND EMBROIDERY, P. Dognin, Liverpool.
14,562. TRANSFERRING ROTATING PARTS, N. Basenach, Liverpool.
14,563. MOTOR VEHICLES, H. H. Lake.—(*M. Giusti and Co., Italy.*)
14,564. FARE INDICATOR for CABS, F. W. G. Bruhn, London.
14,565. VENEERS, H. H. Lake.—(*H. F. D. Wibrow and J. Paul, Germany.*)
14,566. ELECTRICAL RESISTANCE DEVICES, H. H. Lake.—(*Strahlunder Bogen-Lampenfabrik, Gesellschaft mit Beschränkter Haftung, Germany.*)
14,567. GAS, M. Davoren, J. Belton, and J. Davoren, London.
14,568. EXTENSION HANDLE APPLIANCE, A. Saunders, London.
14,569. DEODORISING FATS and OILS, E. Andreoli, London.
14,570. DECOLORISING FATTY MATTERS, E. Andreoli, London.
14,571. CUTTING MACHINE, J. Griffiths and E. Grosskoff, London.
14,572. WARDROBES, J. E. Kennedy, London.
14,573. ELECTRIC LIGHTING SWITCHES, L. Sunderland, London.
14,574. RECEPTACLES, A. Pearse, London.
14,575. ROLLER GEAR WHEELS for CYCLES, C. G. I. Schultz, London.
14,576. SHOES, R. Winzer, London.
14,577. TILTING TRUCKS, W. Ellingen, London.
14,578. COVER for RAILWAY DETONATOR SIGNALS, F. Hess and J. Zigall, London.
14,579. TENEMENT BUILDINGS, A. Turner, London.

*2nd July*, 1898.

14,580. SUPPORTING ARTICLES over GAS BURNERS, C. M. and J. M. Toland, London.
14,581. HOT-AIR HEATING APPARATUS, A. R. Blasse, London.
14,582. BURNING HYDROCARBON, J. Reidenbaugh, E. C. Dresher, and J. T. Monnett, London.
14,583. SASH FASTENER, T. Drew, Plaistow, Essex.
14,584. SECURING LADIES' HAIR into POSITION, J. E. Clennett, Stockton-on-Tees.
14,585. AIR HEATER for JAPANNING STOVES, The Dowler Engineering Company and T. D. Green, Birmingham.
14,586. PNEUMATIC TIRES, W. A. D. Graham, Birmingham.
14,587. GRINDING MACHINES, C. Hofmann, Manchester.
14,588. ADJUSTING the CHAINS of CYCLES, C. Binks, York.
14,589. OBSTETRIC INSTRUMENT, J. Haldane-Huie.—(*C. F. Ponder, India.*)
14,590. TEMPORARY STORAGE of GAS, F. C. Askham, Sheffield.
14,591. DRIVING PULLEYS, W. and W. T. Speed, Sunderland.
14,592. HOLDING LADIES' CYCLING SKIRTS, H. L. A. Timm, Glasgow.
14,593. CARRIAGE LAMPS, W. Whiston, London.
14,594. UMBRELLA CASES, W. T. Hall and J. S. Johnston, London.
14,595. IRONWORK-PRESERVING COMPOSITION, K. B. Skeet, London.
14,596. WEARING APPAREL, R. W. E. Whitehead, London.
14,597. OPENING WINDOWS, E., J., and C. McGloughlin, Limited, London.
14,598. LAMP STOVES, T. Williams, Birmingham.
14,599. ANODES for ELECTRO-DEPOSITION of METALS, F. Greenfield, Birmingham.
14,600. WINDING ENGINES, H. B. Daglish and T. Windus, Liverpool.
14,601. DRESS COLLAR SHOW STUDS, S. Harris, J. E. Sheldon, and C. C. Colley, Birmingham.
14,602. VELOCIPEDE BRAKES, P. Johnston, Wigton, Cumberland.
14,603. ORNAMENTATION of PLAQUES, M. Watts, Birmingham.
14,604. VELOCIPEDE BRAKES, T. T. Hindle and J. E. Wood, Bolton.
14,605. COVERS for METALLIC BOXES, W. A. Read, Liverpool.
14,606. WINDOW-CLEANING BELT, T. Tooby, London.
14,607. PROPULSION of MACHINERY, T. Muckalt, Lancaster.
14,608. COCOA TREATMENTS, G. T. Epstein, Birmingham.
14,609. ROTARY SHUTTLE SEWING MACHINES, N. Munro, Glasgow.
14,610. HYDRAULIC PLATE BENDING MACHINES, J. Fielding, Gloucester.
14,611. MOULDS for MAKING TIRES, J. Maxfield, London.
14,612. DRIVING GEAR for LIFTS and HOISTS, J. Björnstad and Easton, Anderson, and Goolden, Limited, London.
14,613. LOCK, H. N. Abell, London.
14,614. METER, F. Laarmann and H. Brockelt, London.
14,615. FIRE FRAMES, H. Beyer and The Incandescent Fire Mantle and Stove Company, Limited, London.
14,616. ACETYLENE GAS, M. Fournier, London.
14,617. ENAMEL PLATES, A. J. A. Berthelier, Liverpool.
14,618. AERIAL FLYING MACHINE, H. S. F. Warth, Birmingham.
14,619. IMPROVING FURNACE DRAUGHT, W. P. Thompson.—(*A. Brechot, France.*)
14,620. ACETYLENE LAMPS and GENERATORS, E. Smedley, Liverpool.
14,621. FASTENINGS of PACKING CASES, H. Steinberg, London.
14,622. SADDLES, W. Brampton, Birmingham.
14,623. LOOM PICKING MOTION, S. and E. Brookes, London.
14,624. DRIVING GEAR for MANGLES, R. Varley, J. Butterfield, J. Smith, and S. Barret, Keighley.
14,625. INKWELL, J. Tilotson, Keighley.
14,626. STONE-CRUSHING APPARATUS, H. C. Norman, London.
14,627. DYE for TEXTILE FABRICS, S. M. Angel, London.
14,628. COUNTING NEEDLES, P. Jensen.—(*J. Utne, Norway.*)
14,629. COCKS, W. H. Bushell and L. R. S. Tomalin, London.
14,630. CALENDAR, A. Fridl, London.
14,631. ENLARGING PLASTIC OBJECTS, E. Uhlmann, London.
14,632. SHOP WINDOW SHOW FRAME, C. M. Simons, London.
14,633. JOINTING RAILS, P. Hulburd and R. Weatherburn, London.
14,634. CLEARING GAS SERVICE PIPES, H. H. Jones, London.
14,635. TOOL, M. Levi, London.
14,636. ADJUSTABLE STAIR ROD EYE, G. H. C. Butler, Birmingham.
14,637. JOINTLESS PRESSED STAIR ROD EYE, G. H. C. Butler, Birmingham.
14,638. IGNITING LAMPS, P. M. Just ce.—(*F. O. M. Mundy, South African Republic.*)
14,639. STEAM GENERATORS, H. J. C. and J. A. Pattison, London.
14,640. ORDNANCE of LARGE CALIBRE, C. von Hanneken, London.
14,641. RELIEF VALVE for BOTTLES, W. and N. Pirrie, London.
14,642. SERVING WICKS with WAX, A. Ferraguti, London.
14,643. FLOATS used with TRAWL NETS, J. Briggs, Glasgow.
14,644. POLISHING BUFFS, J. Thomson and F. Smart, Glasgow.
14,645. SOLDERING, D. Wells and M. H. Strauss, London.
14,646. SEWING MACHINES for BOOTS, H. S. Ellis, London.
14,647. ZINC OXIDE, R. Matthews, London.
14,648. EXTRACTING CHEMICAL PRODUCTS, L. C. Reese, London.
14,649. TRUNKS, H. King, London.
14,650. ACTIONS of PIANOFORTES, G. O. Heine, London.
14,651. COIN-OPERATED MACHINES, E. Höhmann, Berlin.
14,652. TRIPOD for SUPPORTING CAMERAS, W. Greenwood, London.
14,653. FOOT-REST for CYCLES, J. W. Haughton, Truro.
14,654. BRICK KILNS, W. Heinrichs, Barmen, Germany.
14,655. BLIND CORD, S. H. Keeling and F. C. Smith, Birmingham.
14,656. ROLLER BEARINGS, H. Timken and R. Heinzelman, London.

*4th July*, 1898.

14,657. WATER-CLOSETS, W. Oates, Halifax.
14,658. WEIGHING MACHINES, G. H. Denison, Leeds.
14,659. BULLETS, L. B. Taylor, Birmingham.
14,660. TROUSER FASTENINGS, K. S. Murray and H. J. Chadd, London.
14,661. JOINT for INTERSECTION BOXES, R. A. Douglas, Edinburgh.
14,662. LIVER GELATS, D. Bradford, Somerton, Somerset.
14,663. SPECTACLE CASE, W. Jones, Cardiff.
14,664. SPRAYING APPARATUS, B. R. Phillipson and S. H. Pillar, Dublin.
14,665. CYCLE BRAKE W. Saunders, Kilmarnock.
14,666. ELECTRICAL FUSIBLE CUT-OUTS, A. J. Howard, Taunton.
14,667. NAIL MANUFACTURE, J. Edge.—(*R. Wood, Victoria.*)
14,668. HELMETS, W. Vero, jun., Sheffield.
14,669. STOPPING RUNAWAY HORSES, W. Ullyot, Sheffield.
14,670. CYCLES, W. J. Ginder, Birmingham.
14,671. BICYCLE RESTS, C. A. Roepke Manchester.
14,672. CYCLISTS' SIGNALLING APPARATUS, S. J. Straus, London.
14,673. HUBS, J. S. Edge and J. Hall-Wright, Birmingham.
14,674. ROLLING TUBES, R. Heathfield and G. Palmer, Birmingham.
14,675. SHANKS for BUTTONS, &c., A. Fenwick, Birmingham.
14,676. LOOMS, J. J. Haye, Glasgow.
14,677. BOOTS, R. Gibson, Dunblane, N.B.
14,678. STEAM TOBACCO PIPE CLEANER, F. Holland and A. F. Sherry, Patricroft, near Manchester.
14,679. MOULDING RELIEF MODELS, J. Jaquiss, Cradley Heath, Staffs.
14,680. FURNACE DOORS, J. Lewis, St. Georges, near Wellington, Shropshire.
14,681. PUNCHES for PUNCHING MACHINES, C. Pick, Manchester.
14,682. MOTOR WINDING, W. R. Pidgeon and E. F. Bradley, London.
14,683. PUMP, W. R. Pidgeon and E. F. Bradley, London.
14,684. REGULATOR for TWINE CASES, T. J. Monaghan and D. Longton, Burnley.
14,685. WHEELS and TIRES for CARRIAGES, A. W. Knight, London.
14,686. PURIFYING GASES, J. W. Martin, Clacton-on-Sea, Essex.
14,687. PIN, J. Baum, London.
14,688. PNEUMATIC SADDLE, L. Widdershoven, Glasgow.
14,689. VALVE, J. Qurin, Cologne, Germany.
14,690. CARGO-DISCHARGING APPARATUS, J. Wylie, Glasgow.
14,691. MOUNTING CYCLE WHEELS, F. E. T. Copley, Nottingham.
14,692. WATER-VEHICLE DRIVING GEAR, T. H. A. Lukatis, London.
14,693. SADDLES, T. Webb, London.
14,694. ELECTRIC LAMPS, E. Buchholtz and J. Taylor, London.
14,695. HOPPERED RAILWAY WAGONS, G. W. Ettenger, London.
14,696. WALL PAPER COMPOSITION, P. W. H. Gray, London.
14,697. SPOKES, T. Dawber, Burnley.
14,698. COMPOSITE CIRCULAR SAWS, E. and J. Raybould, London.
14,699. LOCKING CYCLES, E. Schaefer and P. Klose, London.
14,700. BRAKE BLOCKS, R. Thomson, London.
14,701. STRETCHING VIOLIN STRINGS, J. Robertson, London.
14,702. FASTENING WINDOW SASHES, G. L. Monro, London.
14,703. SECURING CARRIAGE DOORS, E. F. Gilbert, London.
14,704. VALVES, J. Coxon, London.
14,705. BATHS, R. Chidlaw and W. Jones, London.
14,706. WHEELS, S. H. Crocker, London.
14,707. ACETYLENE GENERATORS, Sir C. S. Forbes, London.
14,708. DRIVING GEAR, L. E. Cowey, London.
14,709. COIN-CONTROLLED MECHANISM, A. B. Langham, London.
14,710. APPARATUS for DRILLING HOLES, T. V. Woodhouse, Liverpool.
14,711. MOTOR CARS, E. H. Clift, London.
14,712. COUPLING VEHICLES, V. Ullmann and K. Pekarek, Liverpool.
14,713. GENERATING ACETYLENE GAS, H. H. Lake.—(*La Compagnie Continentale d'Incandescence et de Chauffage, Belgium.*)
14,714. VACUUM DIELECTRICS, D. Martini, Farnham, Surrey.
14,715. TUBULAR CONDUITS for ELECTRIC WIRING, T. Taylor, Birmingham.
14,716. OPENER for STOPPERED BOTTLES, E. Horsey, London.
14,717. HOLLOW RIMS for CYCLE WHEELS, W. Deiwiks, London.
14,718. METALLIC CAPSULES for GASES, J. B. Bourseau, London.
14,719. WHEEL COVERINGS, C. Rose.—(*W. N. Blount, India.*)
14,720. DOUBLE-SIDE RULING MACHINE, F. W. Vickery, London.
14,721. COMPOUND LOCOMOTIVE ENGINES, W. M. Smith' London.
14,722. GAS COOKING-STOVES, T. C. Wilson, London.
14,723. MOULDING "BUNCHES," for CIGARS, A. Wool', London.
14,724. RAPID TANNING, G. Feith, London.
14,725. VARIABLE SPEED DRIVING GEAR, W. Erker and O. Löffler, London.
14,726. PRIMARY BATTERIES, W. Rowbotham, London.
14,727. SPRING BAT, G. Echsle, London.
14,728. SULPHUR TRIOXIDE, O. Imray.—(*The Farbwerke vormals Meister, Lucius, and Brüning, Germany.*)
14,729. GENERATING ACETYLENE, G. Gastaldi, London.
14,730. BLACKING BRUSHES, P. Hugo and F. Wittstock, London.
14,731. ETHYL ALCOHOL, O. Imray.—(*G. H. Benjamin, United States.*)
14,732. DISTRIBUTING ELECTRICAL POWER, M. Feri, London.
14,733. MEDICINAL CAPSULES, D. Genese, London.
14,734. ICE-MAKING CELLS, L. Sterne, London.
14,735. AUTOMATIC CAR BRAKES, J. H. K. McCollum, R. Elmsley, and W. H. Brouse, London.
14,736. PROPULSION of VEHICLES, A. L. P. Chasles, London.
14,737. HEATING FEED-WATER for STEAM GENERATORS, J. Oliver, London.
14,738. MUDGUARDS for PNEUMATIC TIRES, S. Dunlop and G. H. Oatway, London.
14,739. ROAD LOCOMOTIVES for AGRICULTURAL PURPOSES, P. J. Parmiter, London.
14,740. SLIDING TUBES, J. P. Mayne, London.
14,741. BOXES for HATCHING EGGS, S. Simmins, London.
14,742. BOOKBINDING, W. Boehner and M. B. Schnauder, Chicago.
14,743. BIRD CAKE, F. F. Lambert, London.

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14,744. TIE CLIP, B. Clarke, jun., London.
14,745. FORMATION of TOBACCO PIPES, G. B. Fanner, Hanley, Staffordshire.
14,746. INDIA-RUBBERS, M. Zingler, London.
14,747. METAL PIPES, F. Schilling and J. Schurz, Halifax.
14,748. SMOKE-CONSUMING FIRE-GRATES, J. Thrush and L. W. de Grave, Derby.
14,749. UMBRELLA FURNITURE, H. Jones, Manchester.
14,750. CONNECTING FLATS to their CHAINS, R. Taylor, jun., Manchester.
14,751. GRINDING MACHINES, C. Hofmann, Manchester.
14,752. BRAKES for RAILWAY WAGONS, E. Warner, Northampton.
14,753. STAYING CARRIAGE WINDOWS when PARTIALLY LOWERED, M. W. Latimer, Belfast.
14,754. COMMUNICATING between PASSENGERS and GUARDS on TRAINS, H. Brownhill, Birmingham.
14,755. COLLARS, A. G. Brookes.—(*The Fenwick Collar and Cuff Machine Company, United States.*)
14,756. COLLARS, A. G. Brookes.—(*The Fenwick Collar and Cuff Machine Company, United States.*)
14,757. CYCLE PEDALS, O. Pihlfeldt, Birmingham.
14,758. STRIPED TEXTILE FABRICS, C. H. Taylor.—(*J. Santoux, France.*)
14,759. PACKING BOTTLES, J. Smith, Glasgow.
14,760. CHALK ATTACHMENT for BILLIARD TABLES, J. Mayer and G. Davies, Hanley.
14,761. ELECTRICAL SAFETY FUSES, W. E. Langdon, Derby.
14,762. CROSS TUBES for VERTICAL BOILERS, I. Morris, Bilston, Staffs.
14,763. SHEET FOLDING MACHINES, E. T. Cleathero, London.
14,764. FIXING YARN in COPS, A. Marr, Manchester.
14,765. FLANGED WHEEL and RAIL BEARINGS, E. Cuffe, Richmond-on-Thames.
14,766. SEWING MACHINES, W. H. Inslee.—(*The Singer Manufacturing Company, United States.*)
14,767. SEWING MACHINE LAP SEAM FELLERS, W. H. Inslee.—(*The Singer Manufacturing Company, United States.*)
14,768. CYCLISTS' HILL CLIMBER, C., J. B., and E. Lane, London.
14,769. LIGHTING CYCLE LAMPS, W. Ward and F. Burris, Bristol.
14,770. LUBRICATING CYCLE GEARING, D. D. Barr, Kilbarchan, Renfrewshire.
14,771. BEEHIVES, W. P. Meadows, Leicester.
14,772. RUDDERS, A. D. Wedgwood, Dumbarton, N.B.
14,773. CLOSING DEVICE for OIL CANS, Rippingille's Albion Lamp Company, Limited, and A. E. Hancock, Birmingham.
14,774. SUPPORTING LAMP GALLERIES, Rippingille's Albion Lamp Co., Limited, and A. E. Hancock, Birmingham.
14,775. TOY, W. Warren, Hanley.
14,776. HAT PINS, W. J. A. Callanan and A. Ronald, London.
14,777. SELF-SEALING PRESERVE JARS, A. Legrand, London.
14,778. PNEUMATIC CUSHIONS, C. A. Allison.—(*W. N. Amory, United States.*)
14,779. LOOM GRID, D. D. Hayhurst and J. Leach, Accrington.
14,780. MAGNESIUM CARBIDE, J. E. T. Woods and W. A. Byrom, London.
14,781. INTERLOCKING DEVICE, A. J. Boult.—(*C. Sears, United States.*)
14,782. ALTERING ROLLING STOCK GAUGE, L. Pearce, London.
14,783. MAXIMUM THERMOMETERS, G. W. Simpson, London.
14,784. HANDLES for CARRIAGE DOORS, F. E. Appleby, London.
14,785. COUPLING DYNAMOS, G. Dettmer, London.
14,786. METHOD of BINDING MUSIC, P. Jackson, London.
14,787. DISPLAYING APPARATUS, A. V. Palmer and E. M. Venning, London.
14,788. FRYING FOODS, P. Ingham and P. Haggas, London.
14,789. KEGS, T. A. Prince, London.
14,790. TRAY, A. P. Jones.—(*J. P. Robertson, New South Wales.*)
14,791. LIQUID FUEL BURNERS, P. Davies, B. Woodcock, and E. Oddy, London.
14,792. PRACTICE of VELOCIPEDE RIDING, J. Dring and E. M. Plummer, London.
14,793. INSULATORS, The British Thomson-Houston Company, Limited.—(*B. Willard, United States.*)
14,794. CHAIN LINKS, P. A. Newton.—(*The Locke Steel Belt Company, United States.*)
14,795. OBTAINING BARYTA, O. Imray.—(*G. E. Junius, France.*)
14,796. SIPHON BOTTLES, A. W. Haig and W. Carter, London.
14,797. ROTARY STEAM ENGINES, J. C. Chapman.—(*M. V. B. Howe, United States.*)
14,798. PIPES, J. Hamblet and J. Parker, Birmingham.
14,799. SYRINGES, A. Pumphery, Birmingham.
14,800. ELECTRICAL HEATERS, R. V. R. Sill, London.
14,801. DRIVING GEAR for VELOCIPEDES, O. Zeland, London.
14,802. SADDLES for VELOCIPEDES, J. S. Wright, London.
14,803. REPRODUCING SOUND RECORDS, G. Bettini, London.
14,804. CARBONIC ACID GAS, W. Saward.—(*E. L. C. Schiff, Holland.*)
14,805. METALLIC WHEEL RIMS, C. K. Welch, London.
14,806. BOTTLE WASHERS, W. J. Cunningham, London.
14,807. CLOTHES RACK, J. Manny, jun., London.
14,808. BANJO MACHINES, C. Sucker, London.
14,809. ELECTRIC ACCUMULATORS, W. H. Smith and W. Willis, London.
14,810. ELECTRIC COUPLINGS, W. J. Davy, London.
14,811. OYSTER OPENER, W. Hicks and R. Hickling, London.
14,812. CAN for PRESERVED FRUITS, J. J. Heins, London.
14,813. STRUCTURE of BRIDGES, E. Easton, London.

14,814. PRODUCTION of PHOTO-RELIEVO IMPRESSIONS, D. Lichtenberg-Madsen, London.
14,815. BANJOES, J. E. Dallas, London.
14,816. GATHERING FRUIT, J. P. O'Neill, London.
14,817. CONNECTING METAL CAPS on ROOFS, F. J. D. Hullinghorst, London.
14,818. PRESERVING MILK, A. Sweetser, London.
14,819. MECHANISM for CARRIER of PILE-CUTTING KNIFE, W. T. Whiteman.—(*The Société Anonyme du Phenix, Belgium.*)
14,820. POLISHING STEEL BALLS, W. P. Thompson.—(*S. Goldmann, Germany.*)
14,821. GUIDES for DIE STOCKS, W. P. Thompson.—(*G. P. Bard, United States.*)
14,822. WRITING SLATE FRAMES, W. P. Thompson.—(*G. M. Beyer, United States.*)
14,823. HEATING and VENTILATING SYSTEMS, W. P. Thompson.—(*The American Incandescent Gas Company, United States.*)
14,824. PANNIKINS for CARRYING MEALS, D. Babbe, London.
14,825. MATCH MACHINES, W. E. Cook, Liverpool.
14,826. ELECTRIC RAILWAYS, R. Belfield.—(*The Westinghouse Electric and Manufacturing Company, United States.*)
14,827. ROLLERS for BENDING IRON PIPES, C. Weber, London.
14,828. TYPE-WRITING MACHINES, H. J. Haddan.—(*The Keystone Typewriter Company, United States.*)
14,829. CYCLES, G. C. Marks.—(*J. Pianes, France.*)

*6th July*, 1898.

14,830. APPARATUS for DRILLING WELLS, S. Adams, London.
14,831. PROTECTIVE GUARDS for TRAMCARS, J. Megown, London
14,832. PNEUMATIC TIRE COVERS, H. J. White, E. Swainson, and S. Shuttleworth, London.
14,833. CABLE INSPECTION CHAMBERS, F. Franklin, London.
14,834. BOTTLES, J. B. Marshall, London.
14,835. ELECTRICAL CURATIVE APPLIANCES, J. Gallegos, London.
14,836. DEVICE for CUTTING OUT PATTERNS, F. Price, London.
14,837. WATER-TIGHT MANHOLE COVERS, R. A. Douglas, Edinburgh.
14,838. HOSIERY, G. F. Sturgess, Leicester.
14,839. ELECTRO DEPOSITION of METALS, E. Andreoli, London.
14,840. CANDLE HOLDER, H. J. Loney and A. J. Jung, Finchley.
14,841. GUARD for CIRCULAR SAWS, J. Campbell, Manchester.
14,842. ATTACHING LEE-BOARDS to BOATS, F. J. Fox, London.
14,843. BALL BEARINGS for CYCLES, B. J. Maloney, Edinburgh.
14,844. SHIP'S BERTHS for HOUSES, A. Almack, London.
14,845. CARDING ENGINES, J. McQueen, G. E. Ross, and A. Griffiths, Manchester.
14,846. CUTTING RASP TEETH, T. P. Lockwood and F. Potts, Sheffield.
14,847. BEARINGS, A. Sowden, Halifax.
14,848. CONCEALED SPRINGS, F. Menzies, A. Urquhart, and A. French, Queensferry.
14,849. SUSPENDING CLIP for UMBRELLAS, F. Cowburn, Blackburn.
14,850. REDUCING MORTALITY of SHEEP, G. M. Laird, Glasgow.
14,851. METAL TUBES, B F. McTear and W. Lindsay, Rainhill, Lancs.
14,852. DOMESTIC FIRE-ESCAPES, L. Franklin, London.
14,853. MUSICAL INSTRUMENTS, W. M. Robinson, V. Needham, and G. Collins, Liverpool.
14,854. SASH FASTENERS, F. E. Walker, Birmingham.
14,855. LITHOGRAPHIC TRANSFERS, J. P. Hewitt and A. E. Blizzard, Hanley, Staffs.
14,856. CRANK DRIVING MECHANISM, J. M. Collins, Glasgow.
14,857. CYCLES, S. Cooper, Manchester.
14,858. GENERATING ACETYLENE GAS, J. E. Scarth, Leeds.
14,859. PICKLE and SUGAR TONGS, F. H. Knights, Harrogate, Yorks.
14,860. TURNOVER DIARIES, W. Collins, Sons, and Co., Limited, and H. Drysdale, jun., Glasgow.
14,861. CLEARER BRACKETS for SPINNING MACHINES, J. G. Nuttall, Rochdale.
14,862. AIR MATTRESSES, J. Liddle.—(*E. E. Samuel, United States.*)
14,863. COMPOSITION for COATING SHIPS' BOTTOMS, R. Seabrook, London.
14,864. CASTORS for FURNITURE, R. S. Knott, London.
14,865. SMOKERS' HANDY PACKET, E. Thomas, Plumstead, Kent.
14,866. PNEUMATIC TIRES for CYCLES, W. J. Torrington, London.
14,867. STRETCHING WIRE MATTRESSES, H. Brown, London.
14,868. PRIMARY BATTERIES, P. Stiens, London.
14,869. PREVENTING the SCATTERING of HORSES' FOOD, A. Neverson, Peakirk, near Peterboro'.
14,870. BLASTING POWDERS, G. Reneke, London.
14,871. HAT BOXES, E. H., E. A., and P. A. Roebuck, London.
14,872. PREVENTING VIBRATIONS of ENGINES, I. Wittenberg, London.
14,873. SHEET and PLATE GLASS, P. T. Sievert, London.
14,874. INCREASING INCANDESCENT GAS LIGHT POWER, J. Lester, London.
14,875. ACTUATING BULKHEAD DOORS, A. W. Montgomery-Moore, London.
14,876. GAMES and PUZZLES, W. A. Whitworth, London.
14,877. SPEED-ALTERING GEAR for MOTOR VEHICLES, I. and T. W. Cordingley, and J. Smith, London.
14,878. WASHING MACHINE, H. Kühne, London.
14,879. COIN-FREED APPARATUS for RAILWAY TICKETS, A. Schoeller, London.
14,880. VENTILATING STRUCTURES, J. Stott, London.
14,881. MAKING COFFEE, W. P. Thompson.—(*M. E. Morel, France.*)
14,882. TOBACCO PIPES, A. C. Greene, Liverpool.
14,883. PICKING BELTS for MINERALS, R. H. Silcock, Liverpool.
14,884. EXERCISING the FINGERS, &c., W. L. Rushton, Liverpool.
14,885. LABELLING TINS, S. Fyfe and W. C. Peacock, Liverpool.
14,886. BOTTLE-LABELLING MACHINES, S. Fife and W. C. Peacock, Liverpool.
14,887. PROPELLING BICYCLES, C. W. Vosper and C. Baker, Exeter.
14,888. CONFETTI, A. Farcat, London.
14,889. DEVICE for WALKING-STICKS, G. W. Smorthwaite, London.
14,890. MOTOR-PROPELLED VEHICLES, E. Latham, London.
14,891. EXPLOSION ENGINES, J. G. Glover and T. Meacock, London.
14,892. APPARATUS for ADVERTISING, C. G. Fricker, London.
14,893. WEEDING IMPLEMENTS, J. Mealor, London.
14,894. RAZOR STROPS, I. A. Keene, London.
14,895. ETHYLENE, W. H. Akester, High Holborn.
14,896. VACUUM BRAKE for TRAINS, J. and H. E. Gresham, Manchester.
14,897. TREATING WOOD, A. J. de Hailes, T. H. Redwood, and H. V. Simpson, London.
14,898. TIRES, J. E. Buckingham, London.
14,899. DECORTICATING MACHINERY, H. Heinrich, London.
14,900. WARDROBE, F. Vogel, London.
14,901. OIL VAPORISER and BURNER, F. B. D. Paynter, London.
14,902. CABLES, L. T. B. Saunderson, London.
14,903. STEERING BAR HANDLES for CYCLES, K. Wagner, London.
14,904. TOBACCO WRAPPER and POUCH, J. S. Cooke, London.
14,905. STUDS, R. H. Edwards, London.
14,906. CHANGEABLE GEAR for CYCLES, J. W. Ortlepp, London.
14,907. ARC LAMP, F. Klostermann, London.
14,908. BED SHEET, P. Chiantore, London.
14,909. ELECTRIC CONDUITS, J. Pefchek, 011 Charlton, Kent.

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14,910. GAME, H. O. and J. O. Roberts, Gloucester.
14,911. OBTAINING ALUMINA, J. T. Hewitt and F. G. Pope, London.
14,912. HATS, H. A. Stewart, Reading.
14,913. ACETYLENE GENERATORS, T. Lyons, Blackburn.
14,914. STRAINER COVER, T. Whyman and T. W. Alsop, Falkirk, N.B.
14,915. CORK, C. H. Matthews and M. E. Park, Newtown, North Wales.
14,916. RIFLE FITTING, W. H. Casley and F. W. Horn, Exeter.
14,917. CLOTH-MERCERISING APPARATUS, J. Nelson, Burnley.
14,918. CONCRETE MIXER, A. H. Owles, Dover.
14,919. NEUTRALISING SMELL of GAS, D. J. Van Praag, London.
14,920. "THE COMPO" SWAGING FLASK," V. Knowles, Reading.
14,921. ADJUSTING TENSION, R. C. Barnes and C. Salmon, Bexley Heath, Kent.
14,922. TROUSER CLIPS, R. P. Forster, Spennymoor, Durham.
14,923. DRIVING GEAR of CYCLES, C. Stewart, Glasgow.
14,924. COLLAPSIBLE PACKING BOXES, G. W. Holttum, Birmingham.
14,925. SPRING PLUG, A. Deacon and T. Bond, Birmingham.
14,926. CENTRIFUGAL PUMP, H. B. Barlow.—(*The Jennings Pump Proprietary, Limited, Victoria.*)
14,927. SLOT IRONS, T. Bullock and H. W. Dalton, Lincoln.
14,928. BEDS, G. A. Billington, Liverpool.
14,929. BRUSHES, F. Newbery, London.
14,930. PLOUGH BIT, R. Richardson, York.
14,931. CYCLES, J. Fletcher, Manchester.
14,932. ADJUSTABLE SEAT for ORGANS, C. F. Brindley, Sheffield.
14,933. WRENCH for STOP TAPS, F. Mills, Sheffield.
14,934. JUNCTION-BOXES, G. A. Clark, W. McAulay, and J. McLaren, Glasgow.
14,935. TIME-CHECKING APPARATUS, J. I. Corbett, Glasgow.
14,936. FLUID-PRESSURE GENERATORS, J. D. MacDonald, Glasgow.
14,937. MACHINES for SEWING BUTTONS on GARMENTS, W. T. Thomson and W. E. Goodyear, Glasgow.
14,938. CYCLE AUTOMATIC LOCK RACKS, A. P. Prout, London.
14,939. FUNNELS for LIQUIDS, A. F. Hanwell, London.
14,940. FACILE FASTENER and BROOCH, A. C. Cockren, London.
14,941. MARKING STITCHES on BOOTS and SHOES, W. Ross, Glasgow.
14,942. BRAKE for VELOCIPEDES, E. B. Killen, Glasgow.
14,943. CAPSULES for BOTTLES, J. G. Bowman, London.
14,944. HAND and WRIST SHIELDS for CYCLISTS, I. M. Blackwood, London.
14,945. FURNACES, H. Pahaut, London.
14,946. CASES for CONTAINING BUTTER, J. and J. H. Whatmough, London.
14,947. TELEGRAPHING without WIRES, W. J. Brooks, London.
14,948. WHEELS for CYCLES, J. Gellatly, Glasgow.
14,949. FIRE-DOORS of FURNACES, J. L. Petit, London.
14,950. LUBRICATORS, F. W. Golby.—(*M. Erendt, Russia.*)
14,951. ALARM KETTLES, H. R. S. Maitland, Brighton.
14,952. BAKING by means of STEAM, H. Sellnick, London.
14,953. ELECTRIC SOUNDING APPARATUS, H. E. Walter, London.
14,954. VENETIAN BLINDS, W. W. Macalister, London.
14,955. LIFTING LOADS, C. S. Snell, Saltash.
14,956. CONVEYING MOTOR LIQUID to GUN MOUNTINGS, W. G. Armstrong, Whitworth, and Co., Limited, and C. H. Murray, London.
14,957. KNIFE-CLEANING APPARATUS, B. A. Spaull and F. G. Bate, London.
14,958. ELECTRIC MOTORS and DYNAMO-ELECTRIC GENERATORS, F. H. Varley, London.
14,959. SWITCH and CONTACT APPARATUS, Siemens Brothers and Co.—(*Siemens and Halske Aktien-Gesellschaft, Germany.*)
14,960. DYEING TEXTILE MATERIALS, L. J. P. Dumons, London.
14,961. COLOURING MATTERS, J. Imray.—(*The Actien-Gesellschaft für Anilin Fabrikation, Germany.*)
14,962. SULPHO-ACIDS of APOSAFRANINES, J. Imray.—(*The Actien-Gesellschaft für Anilin Fabrikation, Germany.*)
14,963. HEATING WATER and GENERATING STEAM, E. Gearing, London.
14,964. GUARDS for CIRCULAR SAWS, A. S. F. Robinson, London.
14,965. PUNCHING HOLES in PHOTOGRAPHIC FILMS, A. S. Newman and Newman and Guardia, Limited, London.
14,966. PUMPS, W. P. Thompson.—(*P. K. Wood, United States.*)
14,967. STOPPERS, A. Fry, Liverpool.
14,968. MECHANICAL STOKERS, F. E. and F. H. Hofmann, London.
14,969. HAT-PIN SHIELD, A. L. M. Peate and E. Owen, London.
14,970. TIRE, F. W. Schroeder and P. W. Moran, London.
14,971. SIFTERS, F. J. G. Rainbow, London.
14,972. ACETYLENE GAS PRODUCTION, H. E. A. Cousin, Edinburgh.
14,973. MACHINES for TURNING the SWATH, T. M. Jarmain, London.
14,974. SCAFFOLDING, F. Knopfe, London.
14,975. BUOYANCY APPARATUS, F. Swanzy, W. Cleaver, and H. Thame, London.
14,976. PROPELLING LIQUIDS, E. Tatham, London.
14,977. VEHICLE TIRES, F. Sichel and J. Ludwig, London.
14,978. MOTOR VEHICLES, A. J. Boult.—(*J. Frankel, France.*)
14,979. PORTABLE BATHS, The X-Chair Patents Company, Limited, and A. E. Anderson, London.
14,980. PNEUMATIC TIRES for CYCLES, T. Bennett, London.
14,981. PUMP, R. C. G. Staats and W. Coates, Old Brompton, Kent.
14,982. BRIDLE, S. V. Buskirk, London.
14,983. MAKING CONNECTION with CABLES, R. J. Hatton and W. T. Henley's Telegraph Works Company, Limited, London.
14,984. DRILLS, J. P. Hartman, London.
14,985. DRIVING GEAR for BICYCLES, W. F. Williams, London.
14,986. MOTORS, Z. Maevsky, London.
14,987. MOTORS, Z. Maevsky, London.
14,988. MOTORS, Z. Maevsky, London.
14,989. PUMP, W. F. Browne, London.
14,990. EXPLOSIVE SHELLS, A. J. Boult.—(*D. M. Mefford, United States.*)

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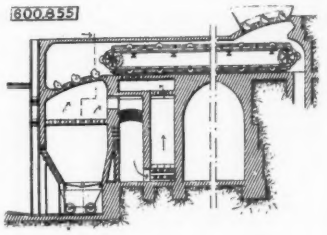
14,991. POSTAGE STAMPS, W. A. E. Crombie, London.
14,992. MOTOR GEAR, T. P. Buckton and J. W. Brown, Halifax.
14,993. HEEL STIFFENERS, E. Clarke, Leicester.
14,994. TROUSER-STRETCHING DEVICE, E. Ward, Birmingham.
14,995. VAPORISERS, J. W. Brown and T. P. Buckton, Halifax.
14,996. STRENGTHENING BAR, R. Brown and Co., Guildford.
14,997. TREATMENT of SEWAGE, G. D. Wild, Cleckheaton, Yorkshire.
14,998. BAT-BLADE GUARD, L. G. H. Oldmeadow, Edinburgh.
14,999. APPARATUS for DAMPING PAPER, D. N. Bertram, Dundee.
15,000. GAS-HEATED SMOOTHING IRON, W. Shannon, Belfast.
15,001. ACETYLENE GAS LAMPS, J. H. Ross, Birmingham.
15,002. FIRE-LIGHTERS, S. Woolley and M. A. Waugh, Liverpool.
15,003. ELECTRIC SWITCH, G. Hill, Manchester.
15,004. STOVES, N Dawson, London.
15,005. CARPET-CLEANING MACHINE, W. and J. Bowie, Glasgow.
15,006. PACKING-CASES, E. Doering, Glasgow.
15,007. TAP-HOLE FITTINGS for CASKS, C. Hartley and R. Forsyth, Manchester.
15,008. RUNNING SHOES, J. Gorman, Edinburgh.
15,009. DOOR HINGES, W. J. Boyle, Liverpool.
15,010. COVER for PANS, H. Seddon, Manchester.
15,011. DRAWING FIBRES off COMBS, W. B. Lee and W. Fisher, Bradford.
15,012. WAIST BELTS, H. J. van Trump, Manchester.
15,013. AUTO-CYCLES, J. Williams, Liverpool.
15,014. ACETYLENE GAS GENERATORS, H. Sutcliffe, Halifax.
15,015. CYCLE SADDLES, J. B. Brooks and J. Holt, Birmingham.
15,016. PROTECTIVE BAND for TIRES, P. McLellan, Glasgow.
15,017. CYCLE STANDS, J. Kirkwood, Glasgow.
15,018. RAILWAY TICKET HOLDERS, H. J. M. Russell, Glasgow.
15,019. SANITARY FLUSHING CISTERN, R. W. McDonald, London.
15,020. ACETYLENE GENERATING APPARATUS, E. Henriquez, Manchester.
15,021. WATERPROOF FABRIC, H. H. Royle and C. Macintosh and Co., Limited, Manchester.
15,022. DRIVING MECHANISM for CYCLES, A. O. de Coul, Glasgow.
15,023. FOUNDATION of CARD CLOTHING, E. Ashworth, Manchester.
15,024. PITCH CHAINS, H. Renold, Manchester.
15,025. NEEDLE-CASE, A. and L. Myers and F. R. Baker, Birmingham.
15,026. NEEDLE for KNITTING MACHINES, J. W. Dyson and E. H. Shaw, Keighley.
15,027. AIR-INFLATED TIRES, J. Reid, Belfast.
15,028. ELECTRODES, H. J. Haddan.—(*C. Francke, Germany.*)
15,029. NAIL-CUTTING MACHINE, C. March, Glasgow.
15,030. TAPE MEASURING ROLLS, W. W. Colley and Colley's Patents, Limited, London.
15,031. CHECK LOCK BOTTLE, H. W. Barton, London.
15,032. FIXING ELECTRIC WIRES, S. W. Mitchell, London.
15,033. FIXTURE BOXES, A. E. Walker, London.
15,034. CIGAR-MAKING MACHINE, H. Birkbeck.—(*F. R. Keys, United States.*)
15,035. DOUBLE PHOTOGRAPH APPARATUS, G. Buhl, London.
15,036. CYCLE BRAKE, A. Guye, London.
15,037. WHEEL SPOKES, P. W. Fraser, London.
15,038. SASH FASTENERS for WINDOWS, E. Harrison, London.
15,039. TROLLEY BASES, H. G. Taylor and R. Gardner, Birmingham.
15,040. AUTOMATIC CIRCUIT BREAKERS, The British Thomson-Houston Company, Limited.—(*E. M. Hewlett, United States.*)
15,041. CIRCUIT BREAKERS, The British Thomson-Houston Company, Limited.—(*E. M. Hewlett, United States.*)
15,042. TEMPERATURE-RECORDING APPARATUS, F. Arenas, London.
15,043. SPEED GEARING for CYCLES, A. J. Boult.—(*A. Lecouvey, France.*)
15,044. GAS BURNERS, T. Landi, London.
15,045. The BALANCING of ENGINES, C. V. Burton, London.
15,046. APPARATUS for WEIGHING, O. O. Ozias, London.

## SELECTED AMERICAN PATENTS.

*From the United States Patent-office Official Gazette.*

**600,855.** GARBAGE-BURNING FURNACE, *J. F. G. de Bonardi, Versailles, and A. D. F. de Villepigue, Paris, France.—Filed January 25th*, 1896.

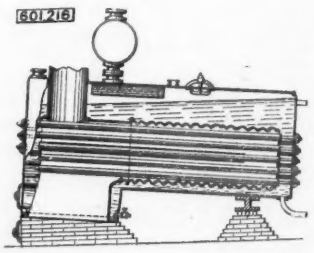
*Claim.*—(1) The herein-described process of treating garbage consisting in distilling the same and then burning the residuum, the distillation being carried on at a relatively low temperature while shielding the fresh garbage from the air and by using some of the heat units developed in the burning of the residuum to raise the temperature of fresh garbage, substantially as described. (2) A garbage distilling and incinerating furnace comprising a distilling chamber, means for feeding the same while shielding it from oxygen, a conveyor for the garbage, an incinerating chamber, means for separating it practically air-tight from the distilling chamber, means for feeding the incinerating chamber with partly distilled garbage from the distilling chamber, while at the same time preventing the fire gases in the incinerating chamber




from passing through the separating vault into the distilling chamber, a heat-reducing communication between the two chambers, means for closing up the furnace against entrance of atmospheric air except that which being necessary for combustion is supplied to the fire-grate by a forced draught, and means for collecting the products of distillation, substantially as herein described and shown and for the purpose set forth.

**601,216.** STEAM BOILER, *J. J. Tonkin, Oswego, N.Y. —Filed February 23rd*, 1897.

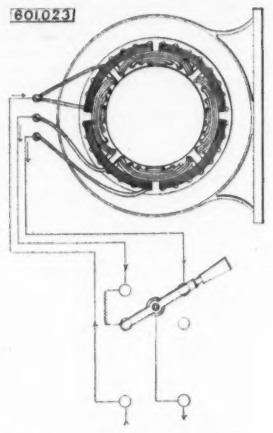
*Claim.*—In a steam boiler, the combination with an




outer shell having a downward extension and an exit flue located above the same, of an inner shell of like form, said inner shell constituting an included fire chamber and combustion chamber, a series of water tubes which traverse the combustion chamber and connect the heads of the inner shell, a horizontal rearwardly-extending deflecting partition composed of a series of brick or tile whose cross-sectional area corresponds substantially with the space included by a group of water tubes, and hand holes in the outer shell and in line with the water tubes, substantially as and for the purposes specified.

**601,023.** ALTERNATING CURRENT MOTOR, *W. Langdon-Davies, London, England.—Filed November 15th*, 1897.

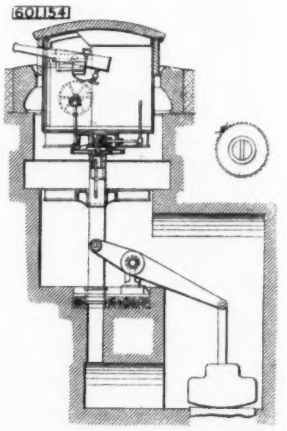
*Claim.*—An alternating-current motor, in which the starting coils are of numerous turns and relatively




high self-induction as compared with the running coils, and in which a resistance is added at starting to the circuit through the running coils, substantially as described.

**601,154.** GUN MOUNTING, *C. Martin, Magdeburg-Buckau, Germany.—Filed June 30th*, 1892.

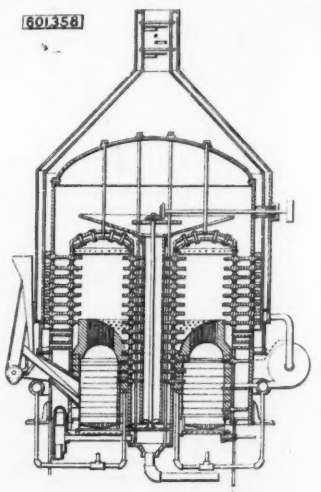
*Claim.*—In heavy ordnance the combination substantially as set forth, of the gun, the central turning




pivot upon which the gun is mounted for training, and the separately-located additional rocking bearing upon which the gun tilts when it is fired or a shot hits the cupola, as explained.

**601,358.** STEAM BOILER AND FURNACE, *H. Stanton, Flushing, Ohio.—Filed May 17th*, 1897.

*Claim.*—(1) The combination in a boiler of a central passage, and a screw working therein to induce a forced circulation, substantially as described. (2) The combination in a boiler of two concentric water chambers, and a concentric grate between them, with a central water passage, and a screw working therein arranged to draw water from the centre passage and force it into the concentric chambers, substantially as described. (3) The combination in a boiler of two concentric water chambers, a concentric grate and fire-box between them, said fire-box being lined with fire-brick and provided with a perforated arch brick dividing the flame space, substantially as described




(4) The combination in a boiler of a smoke passage, a series of absorbing studs projecting therein, and a series of fire-bricks resting on said studs arranged to form spiral passages for the products of combustion, substantially as described. (5) The combination with a circular rotary grate, of a fuel feeder, and means for giving said feeder a faster motion over the inner half of the grate than over the outer half of the same, substantially as described. (6) The combination in a boiler furnace of a fire-box having a brick lining, with an arch brick resting upon said lining, and having an inclined upper surface whose upper edge rises above the flues running through the side of the boiler.

## TESTING MATERIAL FOR ROLLING STOCK.

(*Continued from page 3.*)

### II.—AXLES.

THIS section includes both straight and crank axles, which will be dealt with separately. In many cases guarantees are asked for engine and tender axles, either for mileage or life in years.

#### STRAIGHT AXLES.

Engine and tender axles are usually made from Siemens steel, giving a tensile test of from 25 per cent. in 2in. and 28 to 32 tons per square inch up to 25 per cent. in 3in. and 35 to 40 tons per square inch; carriage axles from Siemens or Bessemer steel ranging from 25 per cent. in 3in. and anything between 30 to 40 tons per square inch, some preferring 28 to 32 tons per square inch, others 35 to 40 tons per square inch. Wagon axles, Bessemer steel, are chiefly made to private owners' specification—25 per cent. in 3in. and 35 tons per square inch; another requirement is 22 per cent. in 4in., 32 to 34 tons per square inch. Some companies require the same tests—usually private owners' standard—for both carriage and wagon axles. Some engine and tender axles are made of Siemens steel of very soft quality—called homo. iron—giving 30 per cent. in 2in., 45 per cent. red. area, 24 to 28 tons per square inch; the journals of these are case-hardened, and are said to show excellent lasting powers. Bending and sometimes drifting tests are specified for axles; the former are useful as a proof of the toughness and ductility, and are usually specified to bend close without fracture. Wrought iron axles are sometimes used for wagons, more rarely for engines; but it must be remembered that there are thousands of iron axles running which were made before successful introduction of steel. They should stand the same falling weight test as steel axles, with a tensile test 25 per cent. in 4in., 22—23 tons per square inch.

Two per cent.—or one in each charge—are tested under falling weight. For engine axles the tests vary from 1 ton falling 30ft. five times up to 1 ton falling 25ft. sixteen times, axle to rest in bearings 3ft. 6in. apart; for carriages and wagons, either 1 ton falling 20ft. six times, bearings 3ft. 6in. apart, or private owners' specification, five blows, 2000 lb., falling 20ft. The axles have to stand all these without showing signs of failure, and are turned after each, or each alternate, blow, the latter being rather more severe. In the case of some engine and bogie axles it may be found that an inside collar rests on the edge of supports; in this case the distance between supports may be widened for convenience sake, otherwise they are forced out and require resetting after each blow.

Deflections given under the falling weight naturally vary with each class and diameter of axle; should equal deflection be wished for each different diameter of axle of a class, the following rule may be used:—

Drop varies as (diameter at centre)$^3$;

thus, in the case of Bessemer wagon axles, starting with 4¼in. diameter at centre, 1 ton falling 20ft., six times, as a standard.

Drop for 1 ton on to 4¼in. diameter, $\frac{h}{H} = \frac{d^3}{D^3}$; $h = \frac{(4\frac{1}{4}\text{in.})^3 \times 20}{(4\frac{3}{4}\text{in.})^3} = 14{\cdot}33\text{ft.}$

This rule gives excellent results; the following table shows the range of deflection given in the case of a very large number of tests:—

| Dia. in. | Weight. ton. | Fall. ft. | Fall. in. | 1st blow. in. | 2nd blow. | 3rd blow. in. | 4th blow. | 5th blow. in. |
|---|---|---|---|---|---|---|---|---|
| 4⅜ | 1 | 20 | 0 | 3 —3¼ | straight | 2⅛—2⅜ | straight | 2⅞—3 |
| 4½ | 1 | 17 | 6 | 3⅛—3⅜ | straight | 2⅜—2⅝ | ttraight | 2⅞—3⅛ |
| 4 | 1 | 12 | 0 | 3¼—3⅜ | straight | 2⅛—2¼ | straight | 2⅞—3 1/16 |

The axle, after standing the drop test, is nicked and broken, a piece taken and sawn into tensile and bending pieces, Fig. 7. Should the first axle of a batch break at or before the last blow, two more are taken, and if one of these should fail the whole batch represented is rejected.

Some engineers take test pieces at ends furthest from fracture, either from the journal or from a special end piece forged on, equal in diameter to the journal. This perhaps gives a slightly better result; a curious case being that of a number of Bessemer wagon axles, from which tests have been taken, Table I.; the tensile piece in many cases has broken close to elongation marks nearest to the fractured portion of axle, Fig. 9, the elongation is reduced owing to this, but ultimate tensile strength and reduction of area have not been noticeably affected.

Breaking axles by continued dropping of weight without nicking is never resorted to as a test; owing to the length of time involved, wagon axles taking 60 to 90 blows, and engine axles even more, before fracture, the axle heating as the process goes on, and thus becoming more ductile. A test for toughness is to deflect an axle to 90 deg. under the tup, afterwards bending it under a hammer until ends touch, Fig. 8. Table VII. gives result of various axles of good quality under tests, Photographs IV. and V. showing good tests obtained from engine (Siemens) and wagon (Bessemer) axles.

Causes which lead to failure under drop test are overheating, forging when too cold, and faulty composition. With regard to the last point, Bessemer wagon axles appear to be adversely affected by a high proportion of S. Table VIII. gives results and analyses of some which have failed under test. It will be noticed that in these cases S is the only constituent present in abnormal quantities, being considerably above the limit, ·05 per cent., usually allowed. An abnormal case is that of some axles by foreign makers, which satisfactorily stood the required tests, although of poor composition, as verified by various analysts; these axles were carefully annealed before going into use.

It will be noticed in one case given in above list that the journal flew off at the third blow. This is not a common occurrence, and may be due to increase of jarring stress at re-entrant angles, or to the journal becoming chilled when being swaged to the finished size.

With regard to axles which have failed in service, failure does not appear to be due to any deterioration capable of being shown by tensile tests. Table IX. gives results of tests and mileage from a few steel engine and wrought iron wagon axles, which ran for so long a period that the journals were under minimum running diameter, and were therefore removed from service. The shape appears to have a good deal to do with failure, a large number of engine axles of good wrought iron having failed at sharp angles—Fig. 12—the flaw showing itself to be a growing one.

The second axle noted above developed a small crack after running 33,876 miles, and was therefore tested under falling weight, &c. The steel of which this axle

Fig. 7.

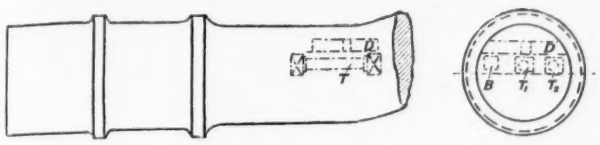



Fig. 8.

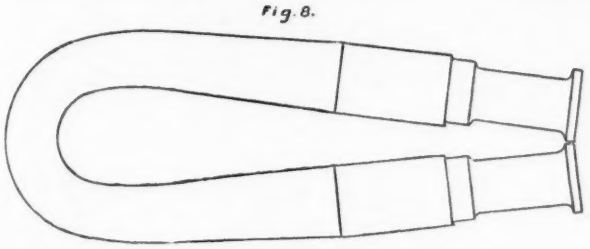


Fig. 9.

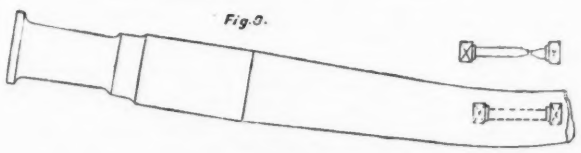


Fig. 10.

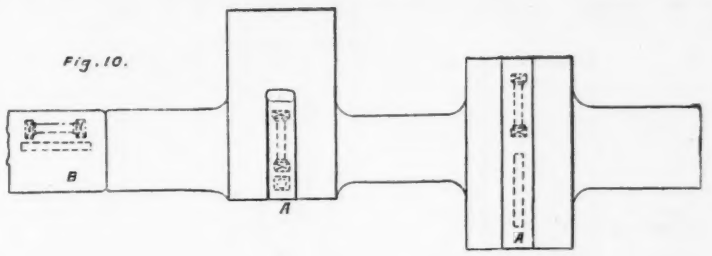
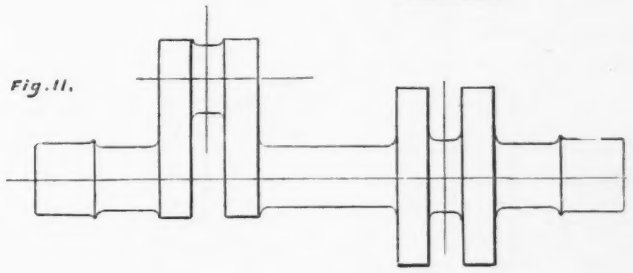
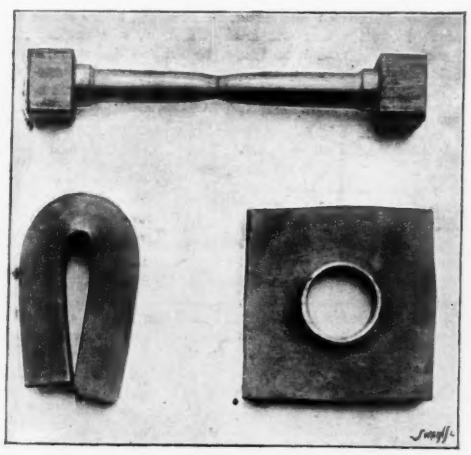


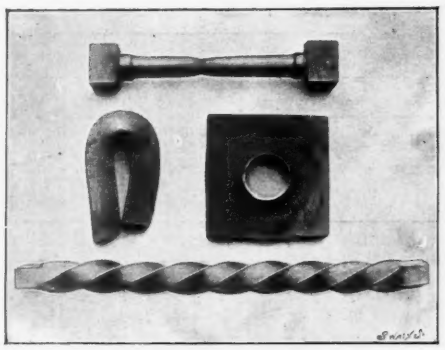

Fig. 11.





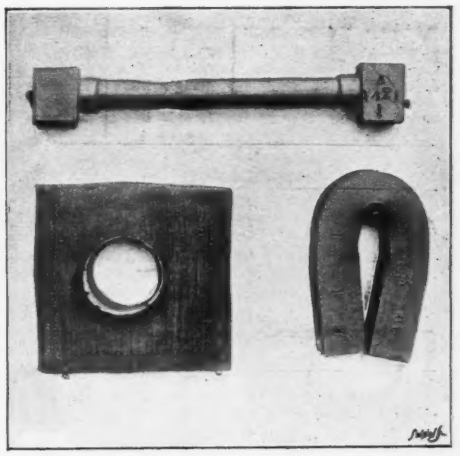
**Photograph IV.—Engine Axle—Siemens Steel**

Analysis—C. ·27, P. ·04, S. ·07, Si. ·05, Mn. ·9
Tensile—Elong. 32 per cent. in 4in., Red. 50 per cent., 29·2 tons sq. inch.
Bend, 180 deg. good. Drift, 1¼in. good.



**Photograph VI.—Crank Axle—Siemens Steel**

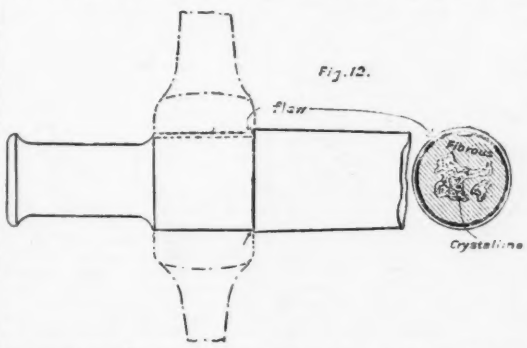
Analysis—C. ·29, P. ·03, S. ·04, Si. ·08, Mn. 1·1
Tensile—28 per cent. in 4in., 56 per cent. Red., 29·5 tons sq. inch.
Bend, 180 deg. good. Drift, 1¼in. good.



**Photograph V.—Wagon Axle—Bessemer Steel**

Analysis—C. ·24, P. ·048, S. ·08, Si. ·051, Mn. 1·03
Tensile—25 per cent. in 4in., 51 per cent. Red., 32·14 tons sq. inch.
Bend, close, good. Drift, 1¼in. good.

Fig. 12.



had been made was, of course, never intended for such a purpose. No. 5 was a bad case of overheating with a fast train. All wrought iron axles above show B. Yorks. quality.

### CRANK AXLES.

These are now made from Siemens steel of high quality, and are required to stand tensile tests varying in different specifications between 25 per cent. in 2in., 28—32 tons per square inch, and 15 per cent. in 2in., 43 tons per square inch; the balance being in favour of a low tensile strength with considerable elongation and bending test 180 deg.

The bending test is of some importance in these axles, as their form and the expense involved precludes any chance of testing them as a whole under falling weight. "Fatigue" tests are sometimes taken; a bar 9in. long, 1¼in. square—cut from crank—placed on bearings 6in. apart, is required to stand twelve blows, 10 cwt. falling 7in., test bar being reversed after each blow.

The tests pieces for all the above tests are cut either from the slabs—A A Fig. 10—slotted out from between the webs or from a piece B, forged for this purpose on the end of the crank journal, the tensile strength being about the same in both cases, but the elongation and reduction of area slightly poorer in the former, owing to the larger amount of work done in forging down the journal end.

A few unhammered cast steel cranks are in service in this country, but may be considered as being in the experimental stage; and a large number of wrought iron and Bessemer steel cranks are running, although the demand for new ones of these sorts is slight.

The hydraulic press is considered by many to be best fitted for turning out good cranks, the slower squeezing action affecting the bloom throughout, which may be noticed on looking at the end of the forgings, which are convex under the press and concave under the hammer, in the latter case due to the blows tending to draw out the exterior of forging. It may, of course, be said that the centre part of throw is cut out, and that the centre of shaft is of the least use to resist torsion, therefore the hammering improves the material where most stressed, but homogeneity is a good point, and torsional stresses are the least important in a locomotive crank, the side shocks due to crossings, &c., being among the most hurtful.

It is the practice of some makers, after rough machining crank axles, to heat them to redness, and then cool them in oil; this no doubt toughens and partially anneals the material, which during the forging and twisting processes has to undergo a good deal of hard usage. The steel is not of high enough temper to be unduly hardened by oil dipping, but as the axles are turned before this process within ¼in. of finished size all over, it is probable that the crank pins and journals are given better wearing powers.

The shape of web is a matter of design, elliptical webs being at present most in favour; the North-Eastern Railway Company use the circular web, which although slightly more expensive to forge, possesses a longer mileage life, and gives great satisfaction. Only three crank axles have failed since their introduction by Mr. T. W. Worsdell in 1885; one being a crank-pin failure, another failing in journal—due to a hidden defect—after running 220,000 miles, the road being by no means an easy one, containing many level crossing lines, &c.

Table X. contains average tensile, &c., tests from various makers of cranks, taken over a large number of samples; Photograph VI. showing average good results obtained from Siemens steel crank axles.

*(To be continued.)*

TABLE VII.—*Falling Weight of One Ton.*

| Description. | Material. | Dia. | Drop. | 1st. | 2nd. | 3rd. | 4th. | 5th. | 6th. | 7th. | 8th. | C. | P. | S. | Si. | Mn. | Elong. 4in. | Red. area. | Ult. stress. |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | | in. | ft. in. | in. | in. | in. | in. | in. | in. | in. | in. | | | | | | | | Tons sq. in. |
| Engine ... | Siemens ... | 5 | 30 0 | 3⅛ | Str. | 3 | Str. | 2⅞ | Str. | 2¾ | Str. | ·27 | ·03 | ·02 | ·19 | ·50 | 23 | 42 | 32·84* |
| Engine ... | Siemens ... | 6¾ | 30 0 | ½ | Str. | ¾ | ⅛ | ¾ | Str. | ⅝ | Str. | ·41 | ·04 | ·02 | ·26 | 1·05 | 26 | 50 | 35·70* |
| Carriage ... | Siemens ... | 4¾ | 30 0 | 3½ | ⅛ | 2⅝ | ¼ | 2½ | ½ | — | — | ·32 | ·05 | ·09 | ·07 | 1·1 | 22 | 42 | 32·66† |
| Carriage ... | Siemens ... | 4¾ | 30 0 | 3¾ | ¼ | 2⅝ | ½ | 3¼ | ¼ | 3 | ⅝ | ·33 | ·04 | ·05 | ·03 | 1·01 | 22 | 36 | 30·70* |
| Wagon .. | Bessemer ... | 4½ | 20 0 | 3½ | ¼ | 2¾ | ¼ | 2¾ | ¼ | — | — | ·29 | ·04 | ·05 | ·09 | 1·08 | 25 | 50 | 35·0* |
| Wagon ... | Bessemer .. | 4½ | 17 6 | 3½ | ¼ | 2¼ | ¼ | 3¼ | ¼ | — | — | ·27 | ·04 | ·05 | ·05 | ·88 | 23 | 42 | 32·5* |

* Close good. † Close broke.

TABLE VIII.—*Axles Failing under Test. Also Faulty Composition.*

| Description. | Material. | 1 ton falling. | 1st. | 2nd. | 3rd. | 4th. | 5th. | 6th. | C. | P. | S. | Si. | Mn. | Elong. 4in. | Red. area. | Ult. stress. |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | | ft. | in. | in. | in. | in. | in. | | | | | | | | | Tons sq. in. |
| Wagon ... | Bessemer .. | 20 | 3¼ | ¼ | 2½ | Str. | 3 | Broke | ·25 | ·04 | ·11 | ·07 | ·95 | 26 | 50 | 32·84 |
| Wagon ... | Bessemer ... | 20 | 3¼ | ¼ | 2⅜ | ¼ | Broke | — | ·24 | ·04 | ·09 | ·05 | ·99 | 23 | 50 | 30·0 |
| Wagon ... | Bessemer ... | 18 | 3⅜ | Broke | — | — | — | — | ·23 | ·04 | ·10 | ·06 | 1·07 | 21 | 54 | 33·7 |
| Wagon ... | Bessemer ... | 18 | 3 | ¼ | 2½* | ¼ | 2½ | Broke | ·27 | ·03 | ·10 | ·03 | 1·03 | 24 | 38 | 30·0 |
| Foreign makers | Bessemer .. | 20 | 3½ | Str. | 3 | Str. | 3½ | Str. | ·34 | ·06 | ·07 | ·23 | ·63 | 25 | 43 | 39·6 |
| | Bessemer ... | 20 | 2¾ | Str. | 2⅜ | Str. | 2½ | Str. | ·32 | ·04 | ·16 | ·16 | ·74 | 3in. 29 | — | 34·00 |

* Journal flew off at third blow.

TABLE IX.—*Axles Failed in or withdrawn from Service.*

| Description. | Material. | Life. | C. | P. | S. | Si. | Mn. | Elong. 4in. | Red. area. | Ult. stress. | Bend. |
|---|---|---|---|---|---|---|---|---|---|---|---|
| 1. Engine, bogie ... ... ... | Siemens ... .. | 45,299 | ·38 | ·05 | ·03 | ·10 | ·48 | 17 | 28 | 39·3 | 110 deg., broke |
| 2. Engine, leading ... ... | Siemens ... ... | 33,876 | ·89 | ·02 | ·04 | ·50 | ·53 | 15 | 36 | 54·5 | 60 deg., broke |
| 3. Wagon ... ... ... .. | Wrought iron... | 26 years | — | — | — | — | — | 35 | 51 | 22·5 | Close good |
| 4. Wagon ... ... ... ... | Wrought iron... | 26 years | — | — | — | — | — | 32 | 45 | 24·6 | — |
| 5. Wagon ... ... ... ... | Wrought iron... | 25 years | | Journal fractured. | | | | 28 | 45 | 22·0 | — |

TABLE X.—*Crank Axle Tests (Averages).*

| Material. | C. | P. | S. | Si. | Mn. | Elong. p.c. 4in. | Red. | Elas. lim. | Ult. stress. | |
|---|---|---|---|---|---|---|---|---|---|---|
| Siemens ... ... ... ... | ·35 | ·03 | ·02 | ·108 | ·86 | 24·2 | — | 21·37 | 35·7 | — |
| Siemens ... ... ... ... | ·27 | ·04 | ·02 | ·14 | ·60 | 22·4 | — | 19·6 | 30·5 | — |
| Siemens ... ... ... ... | ·22 | ·04 | ·05 | ·07 | 1·06 | 25·3 | — | 19·5 | 32·3 | — |
| *Sing'e Tests.* | | | | | | | | | | |
| Siemens ... ... ... ... | — | — | — | — | — | 31 | 52 | — | 26·00 | Web end |
| | | | | | | 37 | 61 | — | 26·00 | |
| Siemens ... ... ... ... | — | — | — | — | — | 28 | 47 | — | 28·0 | Web end |
| | | | | | | 33 | 59 | — | 27·5 | |

THE *Times* AND "THE ENCYCLOPÆDIA BRITANNICA."—Our readers are no doubt aware that our enterprising contemporary has issued an edition of "The Encyclopædia Britannica" at the low price of fourteen guineas, the payments being spread over thirteen months. Our readers will find the particulars on page xxv. A recent issue of the *Times* contains some interesting particulars concerning the history of the great work, from which we take the following paragraph:—"The whole process of producing this reprint is indeed an admirable exemplification of the advantage of manufacturing in vast quantities. About 85 per cent. of the orders thus far received have been orders for the half-morocco binding, so that the average price has been about £17 8s.—much nearer to the £18 price for the half-morocco binding than to the £14 price for the cloth binding. The same proportion would have made the average price, on the former scale, about £43 16s. For every thousand sets the public are, therefore, paying £17,400, as against the £43,800 they were paying at the former price, a clear saving of £26,400 on every thousand sets, or £132,000 on the whole impression of 5000 copies. No one suffers any loss to compensate for this huge gain; a new market has been found for the 'Encyclopædia Britannica,' a good book is finding its way into thousands of homes to which it would never have gone at the higher prices. And the only persons who will have any cause for regret will be those who fail to avail themselves of the opportunity while it exists."

## FRENCH RAILWAYS AND THEIR WORK.

By CHARLES ROUS-MARTEN.

### No. I.—LE CHEMIN DE FER DU NORD.

AFTER losing ten minutes in the actual running—without any signal checks—between London and Dover, and making up all the time in crossing the Channel to Calais—the 25 miles being steamed in exactly 65 minutes by the new boat Lord Warden—I found myself in one of the very comfortable and well-fitted coaches of the Chemin de Fer du Nord, waiting to start from the Calais Station for Paris.

A fellow passenger remarked, "I believe they call this an 'express' in France, don't they?" I suggested that as the journey, a mile longer than from Euston to Manchester, was performed in 21 minutes less time than was the latter journey by the fastest London and North-Western train, and over a far heavier road, with two extra stops, the French train might fairly claim to be an "express" in every sense. He looked surprised, and remarked, "But, of course, they don't really do it; it is only on paper, isn't it? Aren't they always late in Paris?" One could only answer, "You'll see." When, after simply playing with a train of sixteen coaches, we drew up in the Gard du Nord, Paris, nearly three minutes before time, that passenger seemed not only amazed but disquieted. No wonder! He had always believed that the English trains were the fastest in the world. It was a shock of disillusionment to find that after averaging only 39 miles an hour between London and Dover, including one stop, he had averaged 47 miles an hour, including four stops, between Calais and Paris. On the return journey it was no less surprising to average 48 miles an hour from Paris to Calais, and only 39·5 from Dover to London, including stoppages in each case, but with two signal checks in the former case and none in the latter, the French load moreover being the heavier of the two. Experiences of this sort—greatly surpassed by others which I am about to set forth—tend somewhat to abate one's insular conceit.

During October last, and again in May and early June of this year, I made a number of observation trips on the French Northern Railway. In the former case I travelled quite independently and without any intimation to the authorities of the line that I was studying its working, as I was desirous to judge it in its normal condition, and to see for myself whether the very high promise of the time-table was really fulfilled in the ordinary course of work. My experiences were remarkable.

First let me set forth clearly what the Nord lays itself out to do. All the year round, Sundays and week-days alike, it runs two fast day expresses each way between Paris and Calais. Of those from Paris, the 9 a.m. runs to Calais-Ville, 184½ miles—a mile farther than from Euston to Manchester—in 3 h. 46 min., with four stops occupying in all 8 min.; the 11.50 a.m. does the distance in 3 h. 42 min. with one stop. The former train has five separate runs timed respectively at 50·1, 52·6, 51·0, 51·2, and 47·0 miles an hour—the last being over the short distance and steep grade between Boulogne and Calais. The latter has two runs timed at 51·6 and 50·4 respectively. Then there is the 10.30 a.m. boat express to Boulogne, which makes its first run to Amiens—81¾ miles, in 90 min., or at 54·5 miles an hour; and its next, 76¾ miles, to Boulogne, in 90 min., at 51 miles an hour. Next there is the *train de luxe*, run during the tourist season, which is timed to do the 81¾ miles from Paris to Amiens in 85 min., and the 104 thence to Calais Pier in 120 min., the booked average speeds being 57·7 miles an hour and 52·0 respectively, the latter including long slowing approaching and passing Calais-Ville and thence to the pier. There is also a comparatively slow night boat express which is allowed one minute less than the best time from Euston to Manchester, two miles shorter distance. The trains in the opposite direction are allowed a little more time, so as to afford a margin in case of the boats arriving late or the detention for luggage transfer and Customs examination being considerable.

So much for the Paris-Calais main line. But this does not by any means exhaust the list of the Nord's admirable expresses. There is, for instance, the Lille express, leaving Paris at 7.30 p.m., which is timed to reach Longueau Junction, 79 miles, in 90 min., or at 52·6 miles an hour, and then to run to Arras at 51·5. And then there is the splendid *train de luxe* known as the "Nord" express, for Berlin and St. Petersburg, which does the first 95¾ miles to St. Quentin in 102 min., or at the rate of 56·3 miles an hour, and the next 52 miles to Jeumont in the even hour. Beside these there are numerous good trains making runs between stations at the rate of 47 to 50 miles an hour, start to stop; consequently faster than most of the best trains on the English southern railways, and even than many important expresses on the quicker-running British lines.

The following is a list of the expresses on the Chemin de Fer du Nord, timed at 50 miles an hour or more, from start to stop. It may not be absolutely complete; but it is, as near as I have been able to obtain it, up to date. The distances and times are from the official tables.—

| Stations. | Distances in miles. | Times allowed. | Average speeds, miles per hour. |
|---|---|---|---|
| Paris—Amiens ... ... | 81¾ ... ... | 85 ... ... | 57·7 |
| Paris—St. Quentin ... | 95⅞ ... ... | 102 .. ... | 56·3 |
| Paris—Amiens ... ... | 81¾ ... ... | 90 ... ... | 54·5 |
| Paris—Longueau .. ... | 79 ... ... | 90 ... ... | 52·6 |
| Creil—Amiens ... ... | 50 .. ... | 57 ... ... | 52·6 |
| Amiens—Calais Pier ... | 104 ... ... | 120 ... ... | 52·0 |
| Calais Pier—Amiens ... | 104 ... ... | 120 ... ... | 52·0 |
| St. Quentin—Jeumont... | 52 ... ... | 60 ... ... | 52·0 |
| Paris—Amiens ... ... | 81¾ ... ... | 95 ... ... | 51·6 |
| Longueau—Arras... ... | 41¼ ... ... | 48 ... ... | 51·6 |
| Abbeville—Boulogn ... | 49¼ ... ... | 58 ... ... | 51·2 |
| Boulogne—Abbeville ... | 49¼ ... ... | 58 ... ... | 51·2 |
| Amiens—Boulogne ... | 76¾ ... ... | 90 ... ... | 51·2 |
| Amiens—Paris ... ... | 81¾ ... ... | 96 ... ... | 51·1 |
| Amiens—Abbeville ... | 28 .. ... | 33 ... ... | 50·9 |
| Amiens—Calais-Ville ... | 102½ ... ... | 122 ... ... | 50·4 |
| Paris—Creil ... ... ... | 31¾ ... ... | 38 ... ... | 50·1 |

Clearly this is a list of which no railway need feel

ashamed, especially when a long string of runs at 48 and 49 miles an hour can be added. It must at once be admitted that there is no lack of smartness on the Northern Railway of France, so far as timing is concerned. But the question at once arises, How does this fine paper-work come out in actual practice?

It was in order to ascertain this for myself, notwithstanding the existence of an interesting report issued in connection with last year's Brussels Exhibition, which showed excellent performance of the booked promises, which has long been in my possession, and of which an English *précis* has lately been published, that I made the two sets of personal observations to which I referred at the outset. Those in the first set were made, as I have said, quite independently and without the knowledge of the railway authorities. In the second instance, however, I placed myself in communication with M. du Bousquet, the very able Ingenieur-en-Chef du Matériel et de la Traction, who at once, with the utmost courteous readiness, offered to give me all possible facilities in the prosecution of my investigations. That he was in every sense as good as his word, will be seen in the sequel. The result has been that I have obtained a large mass of information, not only highly interesting in its nature, but also of such a character as to cause considerable surprise to those who have not watched the remarkable advance made of late by this most progressive of all the continental railways.

It will perhaps be convenient for me, before recording the work done, to give some brief account of the engines which performed it, and of the road on which it was accomplished. In all cases the engines employed were of the four-cylinder compound type, built at the ateliers of the Société Alsacienne de Constructions Mecaniques, under the direction of M. de Glehn. These engines, of which sixty have been built, of the four-coupled class, the numbers running consecutively onward from 2·121, may be divided into four sub-classes. I should observe here, by the way, that the first figure in the Nord numbering, followed by a point, indicates simply the class of the engine as regards the number of axles coupled, so that "2·" indicates a four-wheel coupled locomotive; "3·" a six-wheel coupled; and "4·" an eight-wheel coupled.

It is unnecessary to enter into details as to the precursor of the four-cylinder compounds, a comparatively small engine built in 1884. Suffice it to say that each pair of cylinders drove an independent pair of driving wheels, as is done in the case of Mr. Drummond's new London and South-Western engine No. 720. It was not until seven years later that the four-cylinder compound engine was definitely adopted by M. du Bousquet for the express work of the Nord Railway. A far larger and more powerful locomotive than the experimental one of 1884 was then designed, and this, with minor variations in detail, has remained the standard type chiefly employed in the fastest services. It is true that an important new departure, which I shall deal with in due course, has been taken very recently. This, however, is simply supplementary to what has been done before, and the engines of the new class will merely supplement, not supersede, the standard type.

For these standard engines certain leading dimensions were adopted at the outset, and have remained ever since unchanged. The diameter of the four driving wheels was fixed at 6ft. 11¼in. with new tires. The length of the boiler is 12ft. 10in. between tube plate. The two high-pressure cylinders are 13·4in. by 25·2in., the two low-pressure cylinders, 20·9in. by 25·2in. These dimensions have never been varied, but continue the same in all the sixty engines of the class.

But whereas the first two engines, Nos. 2·121 and 2·122, had tubes of the ordinary kind giving a heating surface of 1200 square feet; the next fifteen, Nos. 2·123—2·137, built two years later, were fitted with Serve tubes, affording a heating surface of 1553 square feet, to which has to be added 117ft. for the fire-box, making a total heating surface of 1670 square feet, as against 1317 square feet—including fire-box—in the earlier engines. In 1895 twenty more of the locomotives were constructed. These, numbered 2·138 to 2·157, were in all respects but one identical with the previous batch. That single exception, however, was an important one. In both of the earlier sub-classes the steam pressure in the boilers was 198·7 lb. to the square inch. In the new engines the pressure was increased to 214 lb. In 1896 the fourth sub-class of these engines came out, the first being numbered 2·158. The new departure consisted in a material augmentation of the boiler power, the heating surface of the tubes being increased to 1768 square feet, and that of the fire-box to 122 square feet, or a total of 1890 square feet, while the fire-grate area, which had been 22 square feet in the earlier engines, was enlarged to 24 square feet. As the augmented power involved increased consumption of fuel and water, a larger tender was provided running on two four-wheeled bogies, and capable of carrying 4000 gallons of water and a proportionate supply of the briquette fuel, which is chiefly used. In a subsequent article I shall add fuller details of construction. At present I may mention, however, that the high-pressure cylinders are placed outside to the rear of the leading bogie and drive the hinder pair of wheels, which have a straight axle, while the low-pressure cylinders are inside, and drive the forward pair of 6ft. 11¼in. wheels by means of a cranked axle. Also I may note that the steady development of power in the four successive sub-classes of these locomotives has involved a gradual increase in weight—loaded—from 47 tons 16 cwt. to 48 tons 11 cwt., 48 tons 19 cwt., and, finally, 50 tons 9 cwt.

These sixty engines constitute, as I have said, the standard type for the fastest and heaviest express work of the Nord line. But during the last few months a novel type has been brought out, having the same designers and builders as the others, but differing in several important respects. These are ten-wheeled engines, six-wheel coupled, with leading four-wheel bogie. Like the others, they are four-cylindered compounds, but the cylinder diameters are increased to 13·8 in high-pressure power, and 21·6 in low-pressure. The steam pressure is 215 lb., and the heating surface is enlarged to 1950 square feet, the grate area to 24·4 square feet, and the weight loaded to 58 tons 12 cwt. The six driving wheels are 5ft. 8¾in. in diameter. The piston stroke remains 25·2in. It will at once be seen that these engines are of immense size, and possess enormous tractive power.

Their origin was very clearly explained to me by M. du Bousquet. He pointed to a diagram of work done by the four-wheel coupled compounds. "The boats," he said, "not infrequently arrive late at Calais, and then come delays with baggage, mails, &c., so that we often have to start late from Calais. My drivers have to make up as much as possible of that lost time before arrival at Paris. But we are limited by law to a speed of 120 kiloms. (about 75 miles) an hour. As you see by that diagram the engines easily maintain that speed down hill, but cannot attain it on the level or approach it up the banks. Now, as we are not permitted to run faster where we could easily do so, our only course is to increase the speed on the level and up the banks as nearly to that point as possible. That is a very difficult matter, especially with steadily increasing loads, and it can only be effected by employing more powerful engines than even those we have been using of late. The new six-wheel coupled engines are designed to make further progress in this direction."

I shall have occasion later to refer to some performances by the first two locomotives of this new type.

Next, as to the character of the road on which the work was done. That from Paris to Calais may be generally described as presenting in profile four "gables" with an intervening stretch of level. Leaving Paris there is an easy fall the first four miles to St. Denis. Then comes the first gable, a rise of 12½ miles at 1 in 200, followed by a fall at the same rate for 15 miles to Creil. Then comes a virtually unbroken rise for 23 miles, mostly at 1 in 250, and the rest 1 in 300 to 400, and a fall at 1 in 250 and 1 in 330 for 27 miles, forming the second gable. This brings us to Amiens. Then the line is virtually a dead level for about 60 miles, when the third gable, a small one, four miles up and four miles down, is encountered, the gradient each way being 1 in 135. Finally, after Boulogne, a short level and undulating interval precedes the fourth gable, which extends almost to Calais, and has eight miles of 1 in 125 each way, the climb on the northern side being somewhat broken, so that only six miles are continuous, whereas the climb, travelling from Calais, is without any break or "breathing place."

It will thus be seen that the Nord line is far from being "flat as a board" or "level as a table," as it is commonly said to be by those who are not aware of its gradients. For instance, going from Paris to Amiens, the engine has to face the same gradient as that from Wood Green to Potter's Bar, but for half as far again. Then, after a corresponding descent it has to tackle a second climb steeper than that from Sudbury to Tring, and of equal length. Going from Calais toward Boulogne it has the same gradient as that passing Clifton southward toward Shap, and for the same distance. Or it may be compared to the Grayrigg bank on the same line, while it is both steeper and longer than the Desborough bank. So, clearly, the Nord engines have their work cut out.

My first experience was sufficiently surprising. The load was very heavy, the train consisting of twenty coaches, and weighing in all 265 tons behind the tender—that is to say, exclusive of the weight of engine and tender, as all my train-loads are reckoned. The engine was No. 2·158, the pioneer of the latest—sub-class 4—order of the four-coupled compounds. The train was that due to leave Calais Pier at 1 p.m., but owing to the usual detention it did not get away till 1.18, or from Calais-Ville till 1.24.31, instead of 1.6. This was the train which is timed to run thence to Paris, 184½ miles, in 3 h. 54 min. with four stops. What actually happened was as follows:—The train stopped in all 10 min. 4 sec. over the time allowed at the four stations. It was also stopped three times by signal, the aggregate duration of actual stoppage being 3 min. 2 sec. There was, therefore, extra stoppage time to the amount of 13 min. 6 sec., irrespective of the delay caused by the three extra startings and slowings. Yet the train, instead of losing time as might not unreasonably have been expected in such circumstances, especially with a load of 265 tons drawn by one engine, actually gained 2 min. 5 sec. between Calais and Paris. That is to say, there was a total gain between Calais and Paris of 15 min. 11 sec. with that load, on timing 21 minutes faster than the best London and North-Western timing from Euston to Manchester, a mile shorter distance. The actual tested loss by extra starting and slackening for the three signal stops was 8 min. 23 sec., so the engine really gained 23 min. 34 sec. in the running, hauling 265 tons. Every competent judge will certainly agree with me that this was a most remarkable performance.

Its details are equally noteworthy. Leaving Calais-Ville there was only a short level stretch on which to prepare for attacking the eight mile rise of 1 in 125 near Caffiers. Yet the bank was mounted with surprising ease. A distance of 10 miles from the Calais start was done in 14 min. 49 sec., and the speed never fell below 41 miles an hour all the way to the summit. The following descent was made mostly at 65 miles an hour, and Boulogne-Tintelleries was reached in 30 min. 9 sec., the distance being 25 miles. Resuming the journey from Boulogne, another gable—this time at 1 in 135—had to be climbed over, the remaining 40 miles to Abbeville being almost a dead level. Here, after descending the farther side of the gable at 70 miles an hour, the engine maintained a steady rate of 60 to 62 miles an hour, covering the 40 miles in as many minutes, and making the run of 49½ miles from Boulogne to Abbeville, start to stop, in 52 min. 19 sec. This is the same distance as between St. Pancras and Bedford, or Bedford and Leicester. The comparison will illustrate the merit of the work.

Starting from Abbeville, the generally level or slightly rising distance of 22½ miles to passing Ailly-sur-Somme was run in 24 min. 57 sec., but then two vexatious signal stops occurred in succession, the second being outside St. Roch, so that the last 5½ miles from Ailly to Amiens occupied no less than 12 min. 27 sec. But the net time from Calais-Ville to Amiens, 103 miles, was only 113½ minutes with two regular stops, as to which I have allowed nothing for slackening and starting. The actual loss by those two startings and slackenings was 5½ minutes, thus the net time from Calais to Amiens was virtually 108 minutes, with a load of 265 tons, assuming no intermediate stop to have been made. Such work speaks for itself.

At Amiens the engine was changed, and No. 2146, one of sub-class 3, *i.e.*, having slightly less boiler power, came on, the load remaining unaltered. The locomotive work continued equally fine. The climb of 23 miles, almost all at 1 in 250 and 1 in 300, was performed at a steady rate of 53 to 55 miles an hour. Down the subsequent descent toward Creil, speeds of 73, 74, and 75 miles an hour were easily maintained, and the run of just 50 miles from Amiens to Creil was done in 55 min. 23 sec. After Creil the climb of 1 in 200, nearly 15 miles, to the summit near Survilliers, was accomplished in 20 min. 6 sec. from the start, and then came a swift descent, mostly at 72 to 75 miles an hour, until we were brought up sharply by signals at St. Denis, having run the 28 miles from Creil in exactly 32¼ min. The complete running time from Amiens to Paris, with stops at Creil and St. Denis, was 93 min. 37 sec.; but allowing for the time actually lost by those two stops, the net run was 87½ min. Such a performance requires no demonstration of its remarkable merit. And it should be noted that it took place in the ordinary course of things, without any special instructions being given to the drivers, or any knowledge on their part that their work was being so closely scrutinised.

My next experience was with the 10.30 a.m. express for Boulogne and London, the timing of which I have given above. Again I had engine No. 2·158; but the load was much smaller than on the previous occasion, eleven coaches, weighing about 145 tons. The booked time, however, was much faster, viz., 54·5 miles an hour to Amiens. We had run the first 15 miles from Paris in 17½ min., 11 being 1 in 200, when a signal stop detained us for 1 min. 32 sec. at a dead stand, and caused us to lose in all 4¼ min. A signal check at Chantilly lost us another minute; there was the usual service slack through Creil, and a permanent way slack for re-laying lost us yet one minute more. Nevertheless, the gross time from Paris to Amiens, including all stoppages and delays, was only 88 min. 24 sec. If the ascertained loss of time be deducted, the net running time for the 81¾ miles was only 82 min. 9 sec.; and this again in the ordinary course without any special instructions. A speed of 75 miles an hour was several times attained on the falling gradients. Not to extend my details unduly, I may add that the subsequent 76¾ miles to Boulogne were run in exactly 85 min. The same engine went through all the way. The return trip from Boulogne to Paris was spoiled by a block on the line, which compelled the train to travel by the more devious route *viâ* Pontoise, while several signal stops on that length caused further delay.

Another run during my earlier visit was by the 11.50 a.m. from Paris to Calais. In this case the load was 170 tons; the engine 2·146, of sub-class 3. The engine simply played with the train to Amiens, although timed at an average of 51·6 miles an hour, easily making the journey three minutes under time, with two checks. From Amiens, No. 2·135—of sub-class 2—took on the train, running the 102½ miles to Calais-Ville in 118½ minutes, in spite of 3½ minutes being lost through two bad signal slacks. Thus, the net time was seven minutes under the booked time, the latter being at 50·4 miles an hour. All these runs unquestionably imply very fine locomotive work, but they simply represent the customary duty required of the engines and drivers.

*(To be continued.)*

## SAMPLING AND TESTING LUBRICATING OILS AND FATS IN THE WORKSHOP.

*(Concluded from page 51.)*

*The action of alkalies on oils.*—The value of an alkali as a test reagent is threefold, because it serves to distinguish a fat oil from a hydrocarbon oil—fat oils consist of oxygen carbon and hydrogen, but hydrocarbon oils consist of carbon and hydrogen only—but also serves as a means of ascertaining whether a suspected sample is a mixture of fat and hydrocarbon oils.

The principle on which these distinctions are made is very simple. It is this:—Alkalies convert oils of the fat series into soaps of a hard or semi-solid nature; but hydrocarbon oils are not so acted on, the product of the mixing of an alkali with a hydrocarbon oil being an emulsion, of which, however, the compounds generally separate again on standing. It is on these facts that a mixture of the two kinds of oil is ascertained.

*Action of alkalies on fat oils.*—Make a solution of caustic soda or potash having a sp. gr. of 1·340 (at 68 deg. Fah.), put one part by fluid measure of this solution into a long test tube and then pour in two parts fluid measure of the fat oil and shake up the mixture vigorously; a solid mass will be produced—*i.e.*, a soda or potash soap—by the union of the oil and alkali. Allow this to stand undisturbed, when a very small quantity of water will be gathered up beneath the soap. This water has a milky or emulsified appearance.

By making a similar experiment with a hydrocarbon oil no solid soap will be found, but simply an emulsion of the oil and water; but on allowing this to stand undisturbed the oil and water will only exhibit a cloudy appearance, if not absolutely clear.

In the case of a mixture of a fat and a hydrocarbon oil, the product formed on making the above test will vary according to the proportion of mineral oil present. If the fat oil predominates very little trace of the hydrocarbon

oil will be found, as the solid soap that is formed will hold the hydrocarbon oil prisoner. A common soap makes a very good excipient for carrying hydrocarbon oils, or even turpantine, to be combined with a certain quantity of water. If, however, the hydrocarbon be in excess, it will form a layer on top of the soapy mass, while the water that is not taken up in the soap will show itself emulsified. An accurate test to detect mineral oil in fat oils is the following:—Dissolve a piece of caustic soda about the size of a pea in 5 cubic centimetres—written c.c. in future—of alcohol in a test tube; then put in a few drops of the oil to be tested, and heat the mixture over a gas flame, and let it boil for two to three minutes; then add 3 to 4 c.c. of distilled water. If the suspected oil be only a fatty acid, the solution will remain clear; but if a mineral oil be present, even to the extent of only 2 per cent., the solution will be tinted.

To ascertain the exact amount of mineral oil present in a mixture of fat and hydrocarbon oils, note the following experiment:—

Prepare a caustic alcoholic solution of potash or soda of sp. gr. 1·340 (68 deg. Fah.), and mix 10·15 c.c. of the solution with 25 grammes—1 gramme equal 15·43 grains—of the oil to be tested. Add 25 c.c. of distilled water and 5 c.c. of alcohol. Shake the mixture in a glass beaker or boiling tube and allow it to boil for about one hour, constantly stirring it with a glass rod all the time. All the oil will then be saponified. Put the mixture into a separating funnel, add some warm water and 25 c.c. of petroleum ether, shake well together for several minutes, and then allow the mixture to stand undisturbed until it separates into two layers. The mineral oil will be mixed with the petroleum ether in the upper layer, while the lower layer will consist of the soap made from the fatty oil; run off this and add clean water, shake up the mixture again and let it rest a second time. Pour off the aqueous layer. Repeat this operation until the aqueous layer runs off clear, then run the ethereal layer into a weighing glass, the weight of which while dry and clean has been ascertained, gently warm the mixture to drive off the ether by evaporation, and then weigh the oil which is left behind, the difference between the weight of the dry empty weighing bottle and that when it had the oil in, will give the weight of the oil that has been obtained; this weight, multiplied by four, will give the percentage of mineral oil present in the mixture under examination. As many readers may not be acquainted with the metric system of weights and measures, the following are the English equivalents of the above figures:—10 c.c. = 0·6102 cubic inches, or ·1543 grains; 25 c.c. = 1·5255 cubic inches, or ·3857 grains; 5 c.c. = 0·3051 cubic inches, or ·0771 grains; 25 grammes = 385·75 grains.

*Action of sulphuric acid on oils.*—The action of sulphuric acid on oils affords two methods of differentiating oils, one by means of the colour imparted to the mixture of oil and acid, and the other by the temperature of the mixture.

The *colour test* is one which is very easy to perform, but requires experience to be able accurately to distinguish the gradations of colour of the mixture, because the slightest departure from the prescribed procedure brings a difference of tone. The test should be performed always under precisely the same conditions, so as to ensure uniform results. Only in bright daylight can this colour test be made. The operation is performed by putting fifteen to twenty drops of the oil to be tested into a clean, dry, white porcelain evaporating dish, and then let drop into the oil two drops of the acid, of concentrated strength, closely watching until the streaks of colour that are formed in the oil as the acid unites amongst the oily particles becomes, after a short time, of a uniform tint, the colour diffusing itself through the oil. In a minute or two stir the mixture with a glass rod and again watch the colour. That given by vegetable oils are mere traces of yellow, brown, and green. The colours exhibited by fish oils turn off a purple or violet hue, the colour imparted by animal oils turns red or reddish-brown; while mineral—hydrocarbon—oils turn blackish-brown to a slight degree.

To make the test of value it should be a comparative one; that is, the experiment should be made many times, with samples of all the oils in the purest state possible, and the results tabulated, and these tables referred to when testing suspected samples. It is only by long practice and experience that the test can be accurately relied on to distinguish a mixture of several kinds of oil.

*The temperature test* is much more practical, and the way it is performed is this:—Put 20 c.c. of the oil into a glass beaker, and stand a glass thermometer in the oil and note the temperature; then add 8 c.c. of strong sulphuric acid of sp. gr. 1·845, and by the aid of a thermometer, using it as a stirrer, mix the oil and acid together by stirring, and continue stirring until the temperature ceases to rise. 20 c.c. = 1·2204 cubic inches; 8 c.c. = ·00025 cubic inches. Note the highest degree of temperature obtained by the mixture; then, by subtracting the temperature of the oil from the temperature of the mixture, the difference will be the increase of temperature caused by the action of the acid on the oil. Now, as the temperature obtained by the above experiment differs according to the nature of the oil used, this test affords a ready means of ascertaining what is the oil which is under examination then. The general increase of temperature by various oils is as follows:—

| | |
|---|---|
| 11·0 deg. Fah. Scotch shale oil. | 66·0 sperm oil. |
| 45·0 rosin oil. | 67·6 tallow oil. |
| 54·0 petroleum lubricating oil. | 79·2 olive oil. |
| 57·6 neatsfoot oil. | 97·2 castor oil. |
| 63·0 rape oil. | 104·4 rape oil (thickened). |
| | 117·0 cotton-seed oil. |
| | 122·4 linseed oil. |

*To test for the presence of free acid in oils.*—Fatty oils, as they decompose, become rancid, owing to the chemical reactions that occur in them. This rancidity is brought about by the action of oxygen on the oils, whence they become decomposed into the fatty acid constituent and the base glycerine. Other oils that are not fatty oils exhibit traces of free acid. Now it is almost needless to say that such acid is injurious to the machinery on which such oils may be used. Every reader knows how a mere spot of water will cause a spot of rust to form. The rust is an oxide of iron which has been produced by the oxygen in the water uniting itself with the metal and oxidising it. Every one knows the erosive action of rust on iron, and how in time the metal will be eaten into holes. Now the action of an acid is much more energetic, and therefore a lubricating oil that contains acid is a most insidious enemy to the machinery, and it will eat into the delicate parts of the machinery that are out of sight or reach, and thereby set up a loosening or weakening of the parts of the machine where least expected or suspected. This free acid acts on copper or brass as well as on iron and steel after being in contact for some little time. The presence of free acid may be due to imperfect extractions of the oil, or it may be engendered by the reactive changes that occur in keeping the oil for some length of time, because incipient chemical changes are slowly but surely occurring, whereby rancidity or fatty oil acids are developed. As mineral—hydrocarbon—oils are free from the presence of oxygen as a constituent, hence they are generally free from the presence of free acid; but if such oils have been imperfectly washed there are traces of sulphuric acid likely to be present.

*To test for the presence of acid in oils.*—The only test which is trustworthy is to use a tincture of phenol phthalein, and render it alkaline with a little caustic soda, and then shake up the suspected oil with a little of the test reagent. The red colour of the tincture will be discharged if acid be present in the oil. The proportions to add are as much phenol phthalein as will cover a shilling to 10 to 12 oz. of methylated spirit, then add sufficient of the solution of caustic soda to render the fluid perfectly of a reddish tinge. In shaking up a little of the mixture with the oil the presence of acid in the oil is at once shown by the reddish colour disappearing.

*A quantitative test for free acid* in oil is easily made by the aid of the above reaction. The process is this:—Mix 10 grammes—by weight—of the oil with 10 c.c. of neutral methylated spirit or alcohol, stirring the whole time by mixing; then add 1 to 2 c.c. of the above phenol phthalein tincture, place the vessel under a burette, which is filled with a standard decinormal solution of caustic potash or soda; turn the tap of the burette—some burettes are closed with india-rubber tubing and a spring clip instead of a tap—and allow the alkaline solution to drop into the oil mixture. A burette tube graduated in c.c. is the best instrument to use for measuring these quantities. Stir the oil constantly, and watch the moment when a permanent pink tinge remains as the alkaline solution drops in. The *rationale* of the process is this:—When the alkaline solution reaches the oil mixture it produces a pink spot, but this pink colour disappears on stirring the mixture so long as there is any acid in the oil mixture, but when all the oil is neutralised by the caustic alkaline solution the pink colour of the spot is not effaced but remains permanent. When this occurs note the number of c.c. of the alkaline solution that has been required to neutralise the acid in the oil, and for each c.c. of it 0·0282 of oleic acid has been neutralised; by multiplying the resultant number by 10, we get the percentage of acid that is present in the oil.

*To distinguish mineral acids from fat acids in oil.*—Use a solution of methyl orange. Mineral acids, such as sulphuric, will turn this solution pink; but fatty acids, such as oleic, palmic, &c., will not affect it.

*Viscosity of oils.*—By viscosity of an oil is meant its semi-solid condition or body. A thin fluid like paraffin oil has but little body or cohesion, but flows readily; whereas one like castor oil is thick or viscid, and flows slowly. The viscosity is due to the cohesive and adhesive powers of the particles; that is, the particles of a viscid oil like castor oil cohere so well that they will not readily separate or flow freely, while the adhesive quality gives a viscid oil the power of sticking to a surface; the less adhesive power a fluid possesses the easier it flows off a surface. Now, to these qualities—cohesion and adhesion—is given the general term viscosity. It is one of the most valuable properties of a lubricating oil, because the cohesive power permits the oil being thinned by the pressure of heavy bearing, while the adhesive quality prevents oil flowing away from the surface too freely. Now, although viscosity is the chief value of a lubricating oil, the value of such oil must not be gauged by the amount of viscosity of an oil, because a proper application of lubricants consists in using those which are most suited for the special parts of a machine; thus, a bearing like a revolving shaft requires a thick or viscid lubrication so that the particles of oil shall not be too readily pushed asunder by the weight of the shafting, and so thin the oil until it forsakes the bearings altogether. A thinly-fluid oil would be out of place here, whereas, if it be a quickly-revolving spindle that requires lubricating, a thick oil would be out of place; a thin one being the most appropriate. The proper use of lubricants consists in the selection of an oil most suited for the work the lubricated part has to perform, and it is for this reason that the knowledge of the exact viscosity of an oil should be familiar to the engineer. Even in the case of heavy pressure the viscosity must not be too great, otherwise the oil will fail to push its way between the shaftings and bearings, with the result that they will not be lubricated.

A simple and ready means of testing the viscosity of an oil is this:—Take a narrow tube a few inches long, one end of which is drawn to a point, but has a small opening in it; fill this up to a certain mark, mix the oil, and note how many seconds it takes for the oil to drop out.

A series of comparative tests will thus show the comparative viscosities. This test, however, is not a very accurate one, as the viscosity or fluidity of an oil varies according to the temperature at which the test is made. The higher the temperature the thinner the body of the oil becomes, and consequently the quicker it will flow out; but if a uniform temperature, such as 70 deg., 100 deg., 120 deg., 180 deg., and 212 deg. Fah., be adopted, the above simple test will be found sufficiently accurate for most purposes in a workshop. There are several instruments constructed for the purpose of more accurately determining the viscosity of the oil; but unfortunately, owing to the viscosity varying according to the temperature, and the sp. gr. of these oils not being the same, such instruments cannot be made to give absolutely correct results.

The following table shows the relative viscosities of various oils at 70 deg. Fah., and at the boiling point of water, 212 deg. Fah. Rape oil at 70 deg. Fah. = 100 is taken as the standard:—

| 70 deg. Fah. | 212 deg. Fah. | | |
|---|---|---|---|
| 20 | 11 | Scotch mineral oil | Sp. gr. 865 |
| 36 | 10·5 | American mineral oil | ,, 885 |
| 45 | 12 | Scotch mineral oil | ,, 885 |
| 63 | 13·5 | Scotch mineral oil | ,, 890 |
| 66 | 12 | Russian mineral oil | ,, 896 |
| 85 | 12 | American mineral oil | ,, 910 |
| 90 | 12·5 | American mineral oil | ,, 915 |
| 122 | 14 | Russian mineral oil | ,, 908 |
| 127 | 17 | American mineral oil | ,, 920 |
| 221 | 32 | Rosin oil | |
| 236 | 16 | Russian mineral oil | ,, 910 |
| 245 | 17 | Medium machinery oil | |
| 316 | 17 | Russian mineral oil | ,, 914 |
| 1300 | 90 | Summer dark machinery | |
| 1860 | 43 | Cylinder oil | |

It is noticeable that while there is a very great difference of viscosity at 70 deg. Fah., there is a very small difference between any of them at 212 deg. Fah.

*Flash point test.*—Is of great value for determining the safety of an oil for lubricating purposes, but it is one which requires special apparatus for performing the test, and even the accuracy of the results depends on the perfect means the operator has of heating the oil to be tested, because if heated too rapidly the flash point may be many degrees lower than when the oil is carefully and uniformly heated, consequently this test is not satisfactorily undertaken by the operator. All mineral oils when heated to a certain degree evolve vapour which is inflammable. The temperature at which the vapour begins to be given off, and at which it can be ignited by applying a naked flame to it, is called the flash point. Now it requires but a moment's reflection to show how serious might be the results if a lubricating oil became heated higher than its flash point, and so be turned into vapour, because such vapour would fill the air of the room or workshop, and on coming in contact with a naked flame it would ignite with explosive violence. The lowest flashing point of a lubricating oil is 330 deg. Fah. for ordinary purposes, 350 deg. Fah. for cotton mills, and places where there are inflammable materials, while for cylinder oils 500 deg. Fah. is the lowest flashing point that is generally safe. The following table shows the flashing point of hydrocarbon oils used as lubricants:—

| | | |
|---|---|---|
| 318 deg. Fah. | Scotch shale oil | Sp. gr. 865 |
| 320 ,, | Rosin oil | ,, 985 |
| 320 ,, | Pale Russian petroleum oil—residuum | ,, 910 |
| 330 ,, | Scotch shale oil | ,, 875 |
| 342 ,, | Russian petroleum oil—pale | ,, 896 |
| 353 ,, | Scotch shale oil | ,, 885 |
| 376 ,, | ,, ,, ,, | ,, 890 |
| 384 ,, | Russian petroleum oil | ,, 908 |
| 390 ,, | Pale Russian petroleum oil | ,, 914 |
| 392 ,, | American petroleum oil—pale | ,, 903 |
| 422 ,, | ,, ,, | ,, 915 |
| 428 ,, | ,, ,, | ,, 920 |
| 462 ,, | ,, ,, cylinder | ,, — |
| 528 ,, | ,, ,, | — |

*Evaporating test.*—The rate of evaporation of an oil when exposed to air is a test which is easily carried out. Thus, take a concave watch glass, and then put a small quantity of oil into it and weigh again; then put the watch-glass and oil into an oven that has a temperature of 212 deg. Fah., and maintain that heat for twenty-four hours. When taken out, re-weigh the watch-glass and remainder of oil. The loss in weight should not be more than 0·25 to 0·5 per cent.; if more than 1 per cent. is lost, the oil is one that is suspicious and best avoided.

For cylinder oils the temperature of the oven should be 360 deg. Fah., and the heat maintained for five hours only. Chemical tests afford means of determining the nature of the oil, but they can be only successfully undertaken by a person possessing chemical knowledge and experience in manipulating chemical apparatus, therefore such tests do not come within the scope of this article, which is solely intended to put operators in possession of how to test in a general way the oils they use. If more elaborate tests are required, it should be done by an expert analyst in oils.

## THE NEW GRAVING DOCK FOR THE CLYDE.

No. IV.

To complete our account of this important dock, which, since its opening on 27th May last, has been requisitioned to the utmost for the docking of steamers requiring overhaul—as many as four good sized vessels at a time being dealt with, some references to features connected with its construction and equipment are needed. On pages 79 and 86 will be found detailed illustrations of the pumping machinery, with the engine and boiler-house.

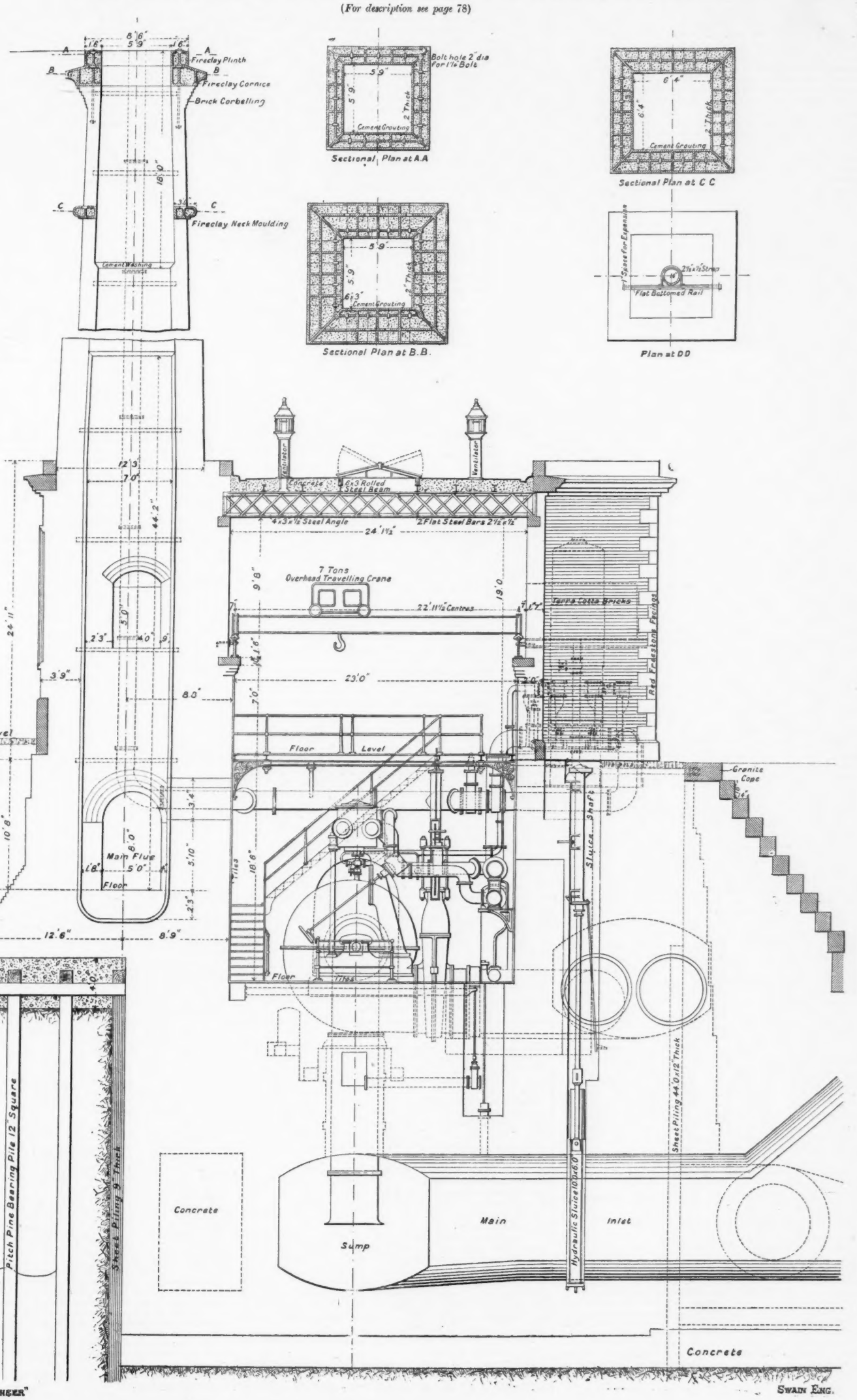
The area occupied by the engine-house, boiler-house, and chimney being limited, sheet piling 9in. thick had to be driven round the south side and both ends of the area occupied by the sump, engine-house, and north half of the chimney, to enable the ground to be excavated deep enough to get the 2ft. thickness of concrete for the brick foundation of the sump founded on undisturbed sand at 53ft. 3in. below the cope level of the entrance to the dock. On this foundation the whole mass of the brickwork of the sump was built to the level of the floor of the engine-house, which is 22½ft. below the level of the cope of the entrance walls. Where the ground was forced, under the walls of the boiler-house, 12in. bearing piles were driven well into the solid ground, and where the foundation of the chimney was outside the sheet piling of the sump area, bearing piles 12in. square, 3ft. apart centres, and ranging from 15ft. to 25ft. long, were also driven, and their heads bedded in concrete 4ft. thick, the top of concrete being 16ft. below the level of cope of body of dock. From the floor of the engine-house, the side and end walls, from 6ft. 6in. thick at the bottom, stepped to 3ft. at the top, extend to the surface of the ground, which is the cope level of the body of the dock. From this level the walls of the engine and boiler-houses rise in a pleasing design outside to the uniform height of 25ft. in terra-cotta brick outside and in, with a red sandstone base course, quoins, rybats, lintels, cornice and blocking course. The roof of the engine-house is flat, covered with concrete, carried on steel girders, and finished on the upper surface with Val-de-Travers asphalte, with a roof light 47ft. long by 7ft. wide, the height from the floor of the engine-house to the ceiling being 40ft. The walls inside are lined to the height of 25½ft. above the floor by white enamelled tiles, and the floor is laid with red adamant tiles.

The floor of the boiler-house is 6in. above the cope level of the body of the dock, and the side walls are 22ft. high. The roof is a pitched iron coupled one, elated, with a skylight and ventilator, 29ft. long by 10ft. 6in. wide. The elevation of the engine and boiler-houses embraces the pedestal of the chimney, and the base course, cornice, and blocking course of these are returned round it and form the base and cornice of the pediment. The chimney is square throughout, and rises 100ft. above the cope level. It measures 12ft. 3in. square outside at the top of the pediment, and 8ft. 6in. outside at the top under the cornice and cope, while the size inside ranges from 7ft. square at the pediment to 5ft. 9in. at the top. The bottom 46ft. 6in. of chimney is lined inside with fire-clay bricks.

The pair of gates dividing the dock into two divisions are constructed of mild steel, and are 46ft. 9in. long from the centre of the heel post to the timber meeting face. The width between the centres of the heel posts is 87ft., and the distance from the line of centres of the heel posts to the apex of meeting sill is 16ft. 7in. The height from the roller path floor to the surface of the cope is 32ft. 9in., the height from the sill level being 2ft. less. The gates are 29ft. 2in high to the top water-tight deck, and are 5ft. 8in. wide at the centre and 2ft. wide at the ends, straight in front and curved on the back. The steel plating forming the front and back of

# PUMPING MACHINERY, GLASGOW GRAVING DOCK

(For description see page 78)




"THE ENGINEER" SWAIN ENG.

the gates is stiffened by three vertical bulkheads, and braced by three intermediate plate decks and seven intermediate braced decks and horizontal bracing. The top of the lowest plate deck—non-water-tight—is 3ft. 6in. above the bottom; the second—non-water-tight—11ft. above the bottom; and the third—water-tight—forming the top of the air chamber, 18ft. 6in. above the bottom. The heel posts and meeting faces are of American white oak, and each gate is surmounted with a platform of the same material carried on T-bars, the surface of the platform being 8in. above the level of the cope. The heel posts rest on cast steel sockets bedded on the specially massive stones already referred to when describing the recess for the gates. The top of each heel post is surmounted by a strong forged wrought iron pin, 16in. diameter by 9½in. deep, fixed to the top of each gate by a palm—of which the pin is a portion—the full breadth of the top of the gate. Each gate is held in position by a strong wrought iron collar, 3½in. maximum thickness by 5½in. deep, bolted to a casting weighing nearly two tons, laid on and bedded in large granite blocks. The casting is anchored to the masonry by three 3¼in. square tie-rods, 16ft. long from the centre of the heel post, buried in the masonry and screwed upon strong cast iron washer plates 2ft. square. The outer end of each gate is carried on a steel roller 28in. in diameter, moving on a cast steel roller path 9in. broad, embedded, as before described, in blocks of granite, built into and flush with the floor of the dock.

Each gate is opened and kept closed as required by a direct-acting hydraulic ram, 14in. diameter and 11ft. 3in. stroke, housed under level of cope of the side walls, and acting on a crosshead and connecting-rod attached to gate, the rod being free to move either horizontally or vertically. The gates weigh 170 tons, and were constructed by Messrs. Robert Stephenson and Co., Limited, Hebburn-on-Tyne, while the hydraulic machinery for working the same was furnished by Sir W. G. Armstrong, Whitworth, and Co., Limited, Elswick, Newcastle-on-Tyne.

The arrangement of keel blocks on the floor of the dock is as follows:—There are 620 sets of portable blocks laid down in three lines, being sufficient for all vessels that would occupy the dock at one time. All of these blocks are of the same length, width, and height, save a few in the way of sills and recesses. They are 5ft. long, 16in. broad, 30in. high, and are each composed of a bottom piece of American elm 8in. thick, then a cast iron plate of the same size 6in. thick, then by a piece of American elm 8in. thick. These three pieces are bolted together, and the block is completed by adding another piece of American elm 8in. thick, which is fixed by two dog spikes on each side to the pieces below.

The dock is equipped with five 5-ton direct-acting hydraulic capstans, one on each side of the outer entrance, one on each side of the inner entrance, and one at the head of the dock in line with centre. The water pressure required to work these capstans, as well as the fourteen sluice valves in the culverts, is obtained from the combined hydraulic installations of Nos. 1 and 2 graving docks and Prince's Dock. The capstans are capable of being wrought by hand-power if required. There are also twelve hand capstans on each side of the dock, and around the dock there are thirty-one cast iron mooring paals.

The dock is in the meantime lit with gas by means of four Bray's lanterns—two at outer and two at inner entrances—and by fourteen 250-candle power Bray's lamps disposed alongside and around the head of the dock, all being carried on oak posts let into cast iron sockets set into the ground.

In the construction of the dock the requisite material of every kind which could be was contracted for, but the excavation and the putting together of the material in the construction of the dock was done by the Clyde Trustees' own plant, and workmen employed by them, under the control and direction of the Engineer-in-Chief and his staff. All the cement used was Portland of the strongest kind, chiefly supplied direct by London manufacturers. All the granite ashlar was supplied by Messrs. John Freeman, Sons, and Co., Limited, Penryn, Cornwall, ready for building, and so correct were the detailed drawings furnished to the contractors, and worked to by them, that the stones were all put in their places without requiring fitting or dressing of any kind. The granite sets for floor of dock were supplied from Cornish and Scotch quarries. The material for concrete was gravel and sand from the excavations for dock, and from the shores of the south-west of Scotland, ballast, broken whinstone, bricks, and crushed granite. The proportion of gravel and other material to cement for concrete in cylinders of wing walls and outer apron was 5 to 1, and the fillings of same, 9 to 1; for floor and sides of dock, 6 to 1; the pockets in brickwork, 9 to 1; the concrete for the moulded granolithic-faced lashlar, 6 to 1; the face, 6in. thick, 3 of crushed granite to 1 of cement; the granolithic altar courses the same; and the concrete bottoming, 4in. thick, under causeway on surface of ground 10 to 1. The mortar for brickwork was composed of 3 of sand to 1 of cement; for the setting of ashlar, 2 of sand to 1 of cement; for the pointing, neat cement; for laying causewaying of floor of dock, 3 of sand to 1 of cement; the grouting of same, 2 of sand to 1 of cement; and the grouting of causeway on surface of ground, 3 of sand to 1 of Arden lime.

The excavations for the dock amounted to 436,000 cubic yards, of which 350,000 cubic yards were conveyed by hopper barges and deposited in Loch Long; 44,000 cubic yards of gravel and sand were used for concrete; and 35,000 cubic yards of sand were sold. There were used in the construction of the dock:—52,600 cubic yards of concrete, 1320 cubic yards of rubble concrete, 46,860 cubic yards of brickwork, 4750 cubic feet freestone ashlar, 58,640 cubic feet of granite ashlar, 5600 square yards of granite nidged causeway, 765 square yards of granolithic causeway, 15,780 square yards of whinstone causeway, 82,000 cubic feet of granolithic altar courses, 26,750 cubic feet of granolithic-faced concrete ashlar, 108,000 cubic feet of timber, 130 tons of cast iron cylinder shoes, 22,300 tons of Portland cement, and 12,200,000 bricks.

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AN ELECTRIC LAUNCH.—An electric launch, built for the Russian Government by the Vril Launches Company, of St. Helens, Isle of Wight, was tried at Portsmouth on Monday in the presence of the Austrian Naval Attaché, and the trial was repeated on Tuesday. The dimensions of the launch tried on Monday are:—Length, 32ft.; beam, 8ft.; depth, 3ft. 8in. There is ample sitting room round the sides of the launch for twenty persons, who are separated by the wheel bulkhead from the coxswain, who is also captain and crew. The maximum current in the Vril boat is 120 ampères, with a pressure of 72 volts, and at full speed with a thousand revolutions, the horse-power developed was eleven and a-half. With this power the vessel was propelled at a speed of seven knots, at which she has a cell storage capacity to enable her to travel for four hours, while at half-speed, or four and a-half knots, she can travel for eight hours.

## THE COAL STRIKE.

ON the verge of Saturday last, when the joint meeting of the Coalowners' Emergency Committee and the Workmen's Provisional Committee was announced to take place, it was generally expected that the end would be in sight. This was the belief, as we happen personally to know, of one of the leading members of the Coalowners' Association; and if, as seems apparent, more difficulties yet block the way, these must be attributed to the sudden and impulsive action of the Workmen's Committee at the last moment in demanding the appointment of an umpire, against which the coalowners are as resolutely opposed as they were to the action of a conciliator.

The meeting took place in Cardiff, and was presided over by Sir W. T. Lewis, Mr. W. Abraham—"Mabon"—occupying the vice-chair. The Workmen's Committee, by their secretary, submitted the following terms as a basis for discussion:—"That the principle of the selling price of coal, automatically applied, shall operate in the regulation of wages, according to a scale of figures to be agreed upon, subject to the following reservation: That in the event of the average selling price of coal coming down below, or going above, a certain point to be agreed upon, the wage rate shall be fixed by a conciliation board, to have a system attached thereto that will ensure a decision in all cases, such conciliation board to deal with all matters in dispute. With regard to 'Mabon's day,' the Committee are prepared to discuss a modification."

The formulated terms were accompanied by the expression of a very earnest wish for an amicable settlement, the Workmen's Committee being then prepared to discuss the amount of an immediate advance. The chairman reciprocated the desire of the workmen for a settlement, and having been assured by the vice-chairman that the representatives had full authority to effect a settlement, and to commit the general body of the workmen to any arrangement that might be entered into, proceeded to discuss the terms. In the matter of "Mabon's day" the workmen were quite prepared to substitute Saturday for Monday. With respect to a definite question from the chair, it was elicited that the workmen regarded it as of vital consideration that an umpire should be appointed. This led to the statement, more than once repeated by the chairman, that the Association would not for a moment entertain the appointment of an umpire. At this point the meeting separated, as the workmen pressed the point, and the chairman positively refused to concede it. After the meeting the Association issued a manifesto, which traversed the terms and contentions of the workmen, and submitted the following amended terms on their part, which they proposed at once to substitute for the list affixed to the pithead at all the collieries.

This is to give notice that from the 18th July, 1898, this colliery will be open for work upon the following terms and conditions:—

(1) The terms and conditions of the old sliding scale, which terminated on the 31st March, to be embodied in an arrangement, to continue in force until January 1st, 1892, and be determined by six months' notice on either side, to be given on the 1st of July, 1901, the 1st January, 1902, and any other following 1st of July or 1st of January.

(2) The monthly holiday, known as "Mabon's day," to be abolished, and no other substituted.

(3) That an immediate advance be given of 5 per cent. above the wages in force on the 31st March.

Since this notice has been issued at the various collieries, meetings have been held, and a formal meeting of the Workmen's Provisional Committee is announced for Monday next, when the result of their deliberations will be made known.

It is understood by those acquainted with the "inner workings" that the large sums remitted by the Northern and Scotch Colliers' Associations, and by the trade union associations generally, have another object than in being purely sympathetic. It has been openly stated by Welsh colliers that they are warned how they act, otherwise relief measures will be withdrawn, and will not again be appended. The bold scheme enunciated of getting a co-operation of trades unionism, and receiving a large revenue weekly, would be sufficient, it is urged, to win any labour struggle. The aim then would be to emulate the tactics of Wellington—splitting an enemy in two, and crushing first one division and then another. This scheme Welsh colliers admit has been tried in Wales, and with success in the house-coal days, before the Coalowners' Association was formed, small coal-owners being attacked in detail; but it is further admitted by the intelligent-minded of the colliers in South Wales that if they secure eventually a good working arrangement of their own they will be better off than in joining any federation.

Last week the amount to hand for relief totalled £6000. This is admitted to meet some part of the distress amongst the colliers, but the condition of the iron and steel workers remains bad and unaffected. A good deal of feeling has been aroused by the statement of various coalowners, published in the local journals, that they repudiate the action of the local boards of guardians in employing strike labour at the expense of the rates. The demand upon them for their part, as rated to the several parishes, they will resist. Already £26,000 has been expended by the Merthyr parish in paying stone breakers one shilling per day and twopence for each child.

One of the most valuable contributions to the mass of evidence *pro* and *con.* of the facts of the case has been supplied by Messrs. Pyman, Watson and Co., one of the leading colliery firms of the Cardiff district. In this letter, which is of considerable length, it is stated that the price of 8s. f.o.b. means a heavy loss, but yielding the colliers 5s. 8d. per ton. That the sliding scale of 8¾ per cent. advance in wages for every shilling advance on the price of coal divides the shilling equally between the employer and workmen, giving them 6d. each. The average price realised in 1897 was 9s. 2d., equal to 1s. 2d. above the standard. The men got half the 1s. 2d.

Since July 1st, 1898, employers' burdens have been increased by the cost of insurance against accidents. By the employers' new proposals the new burden is entirely borne by them.

During the first three months of this year the men working for this company received an average wage of 5s. 9d. per day, after deducting the amount paid to assistant boys. The week preceding the strike the men earned an average wage of 7s. 3d. per day, and the 5 per cent. advance would increase their wages over 3d. per day.

The letter concludes by offering the books of the firm for examination in support.

This week the Workmen's Provisional Committee received the following telegram from Sir E. Fry, the Conciliator appointed by the Board of Trade:—"I think it might be useful to see your Committee. Please fix the time, and reply." After consultation, the Committee named Friday morning for the Conference, which will accordingly take place. On Wednesday a great mass meeting was held by the Aberdare, Merthyr, Plymouth, and Dowlais colliers, for the discussion of the situation. No result is expected to be made public of either meeting until the Monday gathering has been held.

## LARGE GAS ENGINE CONTRACT.

A LONG discussion took place late on Tuesday week at a meeting of the London County Council, consequent upon the presentation of the report of the Main Drainage Committee in regard to the four tenders referred to the Committee for the supply and erection of gas engines required for the proposed new pumping station in Lot's-road, Chelsea. It being elicited that a selection of firms had been invited to tender for the work, the contention was put forth that it would, under the circumstances, be unfair to pass over the lowest offer. The debate was proceeding when it was discovered that there was not a "full house," and the consideration of the question was accordingly adjourned. The following are the tenders:—Campbell Gas Engine Company, £10,000; J. E. H. Andrew and Company, £10,837; Fielding and Platt, £11,350; Crossley Brothers, £11,550.

Reporting on the tenders the Main Drainage Committee said:—"Three other firms were invited to tender for the work, but they were unable to quote for the size of engines required. All the tenderers were asked to submit their own designs, and the drawings of the engine-house are awaiting completion pending the decision of the Council as to the kind of engines to be obtained. Four of the engines required must be double-cylinder engines of 210 indicated horse-power each, and the other four of 260 indicated horse-power each. We find, however, upon inquiry, that the largest single engine built by the Campbell Gas Engine Company is of about 50 indicated horse-power, but we should state that the company offer to commence immediately the manufacture of one of the larger engines under the Council's inspection, and they undertake to make good any defect or error that might be found before proceeding with the remainder. After carefully considering all the circumstances, however, we do not see our way to advise the Council to accept the tender of the Campbell Gas Engine Company, and we regret that we should feel obliged to pass it over on the present occasion. Messrs. J. E. H. Andrew and Co., who are the makers of what is generally known as the "Stockport" gas engine, have manufactured single engines of 140 indicated horse-power, and we recommend that the tender of Messrs. J. E. H. Andrew and Co., Limited, amounting to £10,837 14s., for the manufacture, delivery, and erection of eight double-cylinder gas engines at the Lot's-road pumping station be accepted; that the solicitor be instructed to prepare the contract, and that the seal of the Council be affixed to the contract when ready."

## CATALOGUES.

Burnham, Williams, and Co., Baldwin Locomotive Works, Philadelphia, U.S.A. This is a neat little *brochure*, giving illustrations and particulars of these immense works, which cover 14 acres of ground, and employ 5000 hands solely in the building of locomotives.

The British Non-flammable Wood Company, Limited, Victoria-street, London. History and description of the process by which wood is rendered non-flammable. This little work is got up in a manner which renders it interesting, and contains numerous excellent illustrations, showing the diverse applications to which this material can be put.

The British Luxfer Prism Syndicate, Limited, Hill-street, Finsbury, London. Luxfer prisms for illumination purposes.

The Cape Asbestos Company, Limited, Minories, London. Catalogues of asbestic materials for non-conducting purposes. We understand that this material is being extensively adopted for covering locomotive boilers.

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THE LONDON COUNTY COUNCIL AND WATER GAS.—The Departmental Committee of the Home-office, which is considering the question of the manufacture and supply of water gas, has asked the opinion of the London County Council on the subject. The Public Control Committee of the Council has arrived at the following conclusions on the subject, and these have now been communicated to the Departmental Committee:—(*a*) That considerable danger arises from the introduction of water gas in the process of the enrichment of coal gas. (*b*) That non-carburetted and non-odorised water gas should not be allowed to be used under any conditions, since it is devoid of smell which would give warning of any escape of the gas. (*c*) That 25 per cent. should be the maximum amount of water gas allowed to be introduced in the enrichment of coal gas, the proportion of water gas being ascertained by determining the amount of carbonic oxide in the enriched coal gas, which shall not exceed 16 per cent. Coal gas enriched to this extent would correspond in poisonous character to the Dowson gas, which is already in use for heating purposes and for gas engines, and would exclude the use of carburetted water gas. (*d*) That where it is proposed to supply poisonous enriched gas to houses and the interior of buildings, a proper inspection be made of the service pipes by a responsible officer appointed by the local or other suitable authority, who should certify that the pipes are in a sound condition and that there is no escape of gas; and that the cost of such inspection should be borne by the gas company.

THE DOVER NAVAL HARBOUR.—An excellent impression of the future naval harbour at Dover can be gathered from the illustrations and description which appear in the *Graphic* of last week. On the west is the present Admiralty Pier, which will be extended 2000ft. From the base of the wall to the top of the parapet will be upwards of 90ft., of which nearly 70ft. will be below the level of the high water of spring tides. The area enclosed will be 610 acres at low water, and of the water area to be secured no fewer than 315 acres will be situated beyond the five-fathom line. The anchorage will be sufficient to accommodate twenty first-class battleships, as well as destroyers, gunboats, and smaller vessels. The new Admiralty harbour will, on the eastern side, enclose and protect the commercial harbour. On the western side the sea wall of the smaller harbour will be identical with that of the greater for a part of its distance; but the naval scheme carries the western extension, the Admiralty Pier extension, as it is called, further out. As originally designed, the commercial harbour was intended to cover an area of 56 acres, but this will now be increased to 75 acres—first by carrying the proposed Admiralty Pier extension 640ft. in a southerly direction; and in the second place by lengthening similarly the eastern arm of the commercial harbour considerably beyond the point at first proposed. There will be two entrances to the great harbour—one at the extremity of the eastern arm, the other at the end of the Admiralty Pier extension. The eastern entrance will have a width of 600ft. and a depth of 42ft. at low water of spring tides.

## ALUMINIUM AS A RIVAL OF COPPER AND BRASS FOR ELECTRICAL CONDUCTORS.*

By ALFRED E. HUNT, S.B., President of the Pittsburgh Reduction Company.

COPPER has been used for electrical conductors very largely in the past, due to its comparatively high electrical conductivity, power of withstanding corrosion, ease of soldering and brazing, malleability, tensile strength, and ductility. The exceptions in the past have been in telegraph wires of soft wrought iron, and the brass, iron, and steel used in the parts of electrical machinery. Aluminium has already been used successfully for the purpose, and this article is written to call attention to its comparative merits as an electrical conductor.

The following facts regarding the metals, copper and aluminium, in bars, rods, and wire, suitable for electrical conductors, need first to be considered:—Copper has a specific gravity of 89·3 (authority, Association of Copper Manufacturers of the United States, 1893); an electrical conductivity, when pure and soft annealed reckoned at 100 in the Matthiessen scale, but as ordinarily used in electrical conductors of about 98—97·61 (authority, Professor W. C. Roberts-Austin); a tensile strength of from 16,500 lb. per square inch in soft annealed pure copper (authority, Cargnegie's Hand-book) to 65,000 lb. per square inch in hard-drawn bars; and a selling price of about 14 cents per pound in the United States, and an equivalent selling price of 130 marks per 100 kilos. in Germany for wire, bars, and rods, such as are used for electrical conductors.

Aluminium has a specific gravity of 2·68; an electrical conductivity—commercially pure metal—of 63·00 (authorities, Charles F. Scott, of the Westinghouse Electric Company, and Professor Joseph W. Richards, of Lehigh University); a tensile strength in pure soft wire of 26,000 lb. per square inch, and in hard-drawn rods or wire of 40,000 lb. per square inch.

Special selling price:—The firm of Aron Hirsch and Son, of Halberstadt, Germany, are ready to sell aluminium conductors in the form of rods, bars, plates, and wire drawn to 2½ mm. in diameter, at the special low rate of 280 marks per 100 kilos., for large quantities of metal; and similarly the Pittsburgh Reduction Company will sell rods, bars, plates, and wire drawn down to No. 12 Brown and Sharpe gauge—eight hundredths of an inch diameter—in large special orders for electrical conductors, at the rate of 29 cents per pound at their works in the United States. These prices are special rates, below the regular prices for aluminium which these concerns have decided to make for electrical conductors alone, in order to favour the introduction of aluminium for this purpose, and to overcome the handicap which aluminium has, occasioned by its lower electrical conductivity than copper, in the matter of special low relative prices. From these facts it is evident that:—

(1) Any given volume of copper is $\frac{8·93}{2·68}$ or 3·332 times heavier than an equal volume of aluminium.

(2) The equivalent price of 14 cents per pound for copper for any length of any equivalent section of aluminium wire or bar would be 14 cents times the factor 3·332, or 46·65 cents per pound. That is, 1000ft. of wire of, say, one-tenth inch diameter, would cost equally as much if bought of copper at 14 cents per pound, or aluminium at 46 65 cents per pound. Aluminium therefore sold at 29 cents per pound is only about 62 per cent. of the cost of copper at 14 cents per pound section for section.

(3) Reckoning the copper conductor to have its maximum of 100 per cent. conductivity, and the aluminium to have a conductivity of 63 per cent.—which the Pittsburgh Reduction Company are ready to guarantee for their special pure aluminium metal for electrical conductors—then for an equivalent electrical conductivity a given section of copper that can be placed at 100 should be increased in area in round numbers to 160 to give an equal conductivity.

(4) Due to their relative specific gravities, the weight of the given equal length of the aluminium conductor with 160 sectional area will be only 48 per cent. of the weight of the copper conductor with sectional area of 100, having the same electrical conductivity.

$100 \times 8·93 = 893$, weight of the copper.

$160 \times 2·68 = 428·8$, weight of the aluminium.

$\frac{428·8}{893} = 48$ per cent.

(5) As to their relative cost for electrical conductors of equal conductivity, aluminium at 29 cents per pound is the most economical conductor as compared with copper at 14 cents per pound. Taking as an illustration an aluminium conductor to replace a copper wire of No. 10 B. and S. gauge—about one-tenth of an inch diameter—the aluminium wire of equal, in fact somewhat superior, electrical conductivity would be of No. 8 B. and S. gauge, slightly over one-eighth of an inch diameter. The weight of a mile of No. 10 copper wire is 162·32 lb., and its cost at 14 cents per pound would be equal to 22·72 dols. The weight of a mile of No. 8 aluminium wire would be 79·46 lb., and at 29 cents per pound would cost 23·04 dols. 48 per cent. of the weight of the No. 10 copper wire, which will give equal electrical conductivity in aluminium wire, would only weigh 77·91 lb., so that more accurately 22·59 dols. would be the cost of a mile of aluminium wire at 29 cents per pound to replace a mile of No. 10 copper wire at 14 cents per pound. costing 22·72 dols.

(6) The Continental requirements in tensile strength for soft copper wire, rods, and bars used as electrical conductors is 22 kilos. per square millimetre, the English requirement being similarly 14 tons per square inch, and our American requirement is about its equivalent of 32,000 lb. per square inch.

Aluminium wire, rods, and bars will be furnished of 63 per cent. electrical conductivity, which will have an equal tensile strength per unit of area with the copper, and therefore with the electrical conductivity equivalent of 48 per cent. of the weight of the copper, and sectional area of 160 against the area of the copper section 100, the tensile strength of the aluminium conductors will be as 100 for the copper is to 160 for the aluminium. This would mean if a square inch of copper conductor was used of, say, 32,000 lb. per square inch tensile strength, the equal conductivity area of 1·6in. of aluminium would have a tensile strength of 51,200 lb.

It has been already determined that with aërial lines the snow and ice load is practically as heavy on lengths of small wire as upon larger sections, so that no objection upon this score can probably be found to the use of the larger sections of aluminium wire.

Both on account of having only 48 per cent. of the weight and on account of having about 60 per cent. more strength, the aluminium conductor could be used in much longer spans between supports, and the number of expensive poles and insulators can be materially diminished. Properly-drawn aluminium wire is as tough, and will stand bending as severely without breaking as soft copper wire. The toughness of aluminium wire is, however, greatly modified by the care and skill used in manufacture. If it is drawn too severely through the dies, or is not well annealed at the proper intervals in the drawing operation, it is finished much more brittle than when properly manipulated.

Hard-drawn copper wire, especially that in the smaller sections drawn through diamond dies, is furnished with a tensile strength of 65,000 lb. per square inch. What the maximum tensile strength of the best pure hard-drawn aluminium will reach under similar favourable conditions for developing the maximum tensile results has not yet been determined, but from experiments already made it can quite surely be predicted that at least 50,000 lb. per square inch can be obtained, and perhaps even higher strength still.

Aluminium hardened with a few per cent. of alloying ingredients can be furnished in wire with a tensile strength far in excess of what can be obtained in pure aluminium. Experiments are now being made by the Pittsburgh Reduction Company to determine just what alloy will furnish the maximum tensile strength, together with maximum electrical conductivity. From results already obtained, it can surely be predicted that an alloy of aluminium can be furnished which drawn into wire will have a tensile strength of at least 65,000 lb. per square inch, and electrical conductivity of more than 50 in the Matthiessen scale. This material to rival hard-drawn copper wire and the silicon-bronze materials which are now in use, where maximum tensile strength together with good electrical conductivity are required.

The power of withstanding corrosion is greatly in favour of aluminium as an electrical conductor over copper. Copper does not change in dry air, but in moist air it becomes covered with a green layer of basic carbonate of copper, which itself has a corroding action and does not coat and protect the underlying copper from further corrosion. Ammonia in contact with copper absorbs oxygen and the copper dissolved in consequence of the formation of a soluble cupric-oxide and ammonia. This action is especially a source of trouble where copper wire is used in connecting rail joints in the tracks of electrical railroads, where the ground is often subjected to ammoniacal solutions. Aluminium similarly is not acted upon in dry air, and the corrosion in moist air is of the oxide of aluminium, alumina, a harmless salt which forms an impenetrable coating on the metal, and protects it from further corrosion to a considerable extent. Ammonia solutions act on aluminium only upon the surface, attacking it and leaving behind a more resisting surface coating of a brown colour containing silicon, which resists corrosion from dilute mineral acids and dilute solutions of organic acids as well as moist and dry air. Subject to sulphur gases, such as locomotive flue gases, aluminium withstands corrosion better than copper.

If kept free from galvanic action with any other metals electro-negative to itself, aluminium is far less easily corroded than copper.

The difficulty of soldering or brazing aluminium is the chief drawback to its use as an electrical conductor. Aluminium can be soldered strongly, but it is a more difficult and slow operation at best as compared with copper, and there is much more rapid weakening of the soldered joint due to galvanic action between aluminium and the metals of the solder than with the less electro-positive metal, copper. In many places the aluminium can be first coated with copper, and the soldering or brazing operation made on the copper surfaces thus formed.

Several forms of joints have been successfully used to avoid the necessity of soldering, the best forms being to use thin aluminium sheets to wrap the joints and to twist or otherwise bind with the aluminium bars or wires to be joined. These wrapped and twisted joints with aluminium sheets can be left smooth on the outside when desired, can be made much stronger than the body of the conductors, and are really a more serviceable job than soldered or brazed work in many cases with copper. One very practical way of making joints of aluminium wire is to roll the thin aluminium sheet of about 6in. width into two cylinders from opposite edges of the sheet. These double cylinders are very cheaply made on mandrels in a lathe. The ends of the wires to be joined are inserted in these cylinders from opposite ends, and both the wire and sheet twisted with pliers until a firm joint is secured, much stronger than the body of the wire. The joint can readily be made impervious to the air and moisture.

The C. McIntyre Company, of Newark, N.J., have a patented joint which is made very much along the lines of this joint. Information regarding their patented form of joint can be obtained by correspondence with them as above. Also the American Electric Tube Company, Chicago, Ill., make a very satisfactory joint.

Another disadvantage which handicaps aluminium in special uses for electrical conductors will be where the material has to be insulated that the cost of insulation will be approximately one-third greater for the larger section required in aluminium over the cost for the smaller section of copper required for the given conductors; and where aluminium is to economically compete for insulated conductors, the price of the aluminium will have to be further reduced to meet this contingency. Aluminium is soon to be placed in an extensive line of conductors where this added extra cost of insulation will be determined by actual fabrication; the Pittsburgh Reduction Company in this particular case agreeing to pay the added costs, in order that actual experience may be gained as to their relative amounts.

There are certain places where aluminium will be at a disadvantage over the smaller section of equal conductivity of copper, in ducts or conduits where space is a considerable item. In such cases, the use of aluminium would necessarily be prevented. An ample field for the employment of aluminium for some time to come, however, seems open at the present time for bare transmission lines, especially for high potential long-distance work, and for long-distance telephone lines and for rapid-transmission telegraph lines.

Aluminium, next to gold, is the most malleable of all the metals, and is much more malleable than copper. Aluminium in ductility stands next to copper, and is easily drawn into all sections that are furnished in copper for electrical conductors. Alluminium can be furnished fully as uniform in its composition as copper. The metallurgy of copper is comparatively complicated, owing to the difficulty of converting its ores into the oxide free from impurities. In most of the copper ore used, sulphur, lead, and iron are contained, as well as small quantities of other elements, as arsenic and antimony. All of these elements in metallic copper very materially lower its electrical conductivity. The native pure copper of the Lake Superior region enjoys the preference due to its uniformity and freedom from impurities for many purposes, but for electrical conductors the electrolytic copper is most used. Aluminium can now be furnished rivalling for electrical conductors at least 99·50 pure—it is granted, not as yet in purity of composition the best electrolytic copper used for the purpose of electrical conductors. When as pure a metal is obtainable, undoubtedly it will more nearly rival copper in electrical conductivity, section for section.

Aluminium has been already in successful operation as an electrical conductor for some time. The first use in a large way was with the conductors for the electric current at the Niagara Falls Works of the Pittsburgh Reduction Company, where it has been used since the year 1895; the currents were of several thousand horse-power each, and of very large volume and comparatively low voltage. Both in conducting power, freedom from heating effects, power of withstanding corrosion, ease of making, wear, and efficiency of joints, the aluminium conductors have given better results than copper used for the same purpose.

In the Chicago Stock Yards a mile of aluminium wire of No. 11 gauge has now been in use for some time, upon a telephone line that has been badly corroded out in copper wire, due to its being frequently subjected to sulphur gases from passing locomotives. The aluminium line is giving good satisfaction, and is withstanding corrosion much better than did the original coper wire subjected to the same influence.

If the theory be true that the passage of high-voltage alternating currents of great frequency is largely upon or near the surface of the conductors only or mainly, then the larger section of the proposed aluminium conductors will make them especially adaptable for such currents.

On telephone lines it has already been determined that as good sound transmission is obtained with aluminium of equal section as with copper, in ordinary lengths of less than ten miles of wire. No comparative results, however, have as yet been determined on long-distance telephone transmission; but the evidence would seem to point that a much less section than 160 of aluminium to 100 of copper will give equally good results.

Aluminium is now being used to replace brass very considerably in the arts, as it is sold in the open market at rates which make it 10 per cent. cheaper section for section, than brass. For electrical purposes the metal can be advantageously used to replace brass in a good many ways. Commercially pure aluminium as furnished to-day contains less iron than does commercial brass, and is therefore more non-magnetic than brass.

The electrical conductivity of aluminium is far superior, section for section, to brass. Almost every electrical apparatus of present construction in which an iron core—usually a laminated iron core—is used in motors, generators, or transforming machinery, has spaces for ventilation, and the spacing is made by the means of drawn bars, flat rods or angles, or tee-shape pieces. Brass has been almost invariably used for this purpose in the past, probably on account of its non-magnitic properties as compared with iron or steel. Drawn aluminium sections can be furnished at a price which is 10 per cent. cheaper than brass, section for section; and on account of the lightness of aluminium it can be advantageously used.

Where a low electrical conductivity is desirable, as in parts that are moved in a magnetic field, to prevent the occurrence of eddy currents, aluminium can be alloyed with zinc and other metals that will lower its electrical conductivity to the desired points.

* Read before the American Institution of Electrical Engineers.

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ROYAL ARSENAL ASSOCIATION OF FOREMEN.—About twenty-five members of this Association paid a visit on Saturday last to the works now in course of construction in Holborn for the Central London Railway. Thanks to the courtesy of Sir Benjamin Baker, every assistance was given by the officials to make the visit instructive.

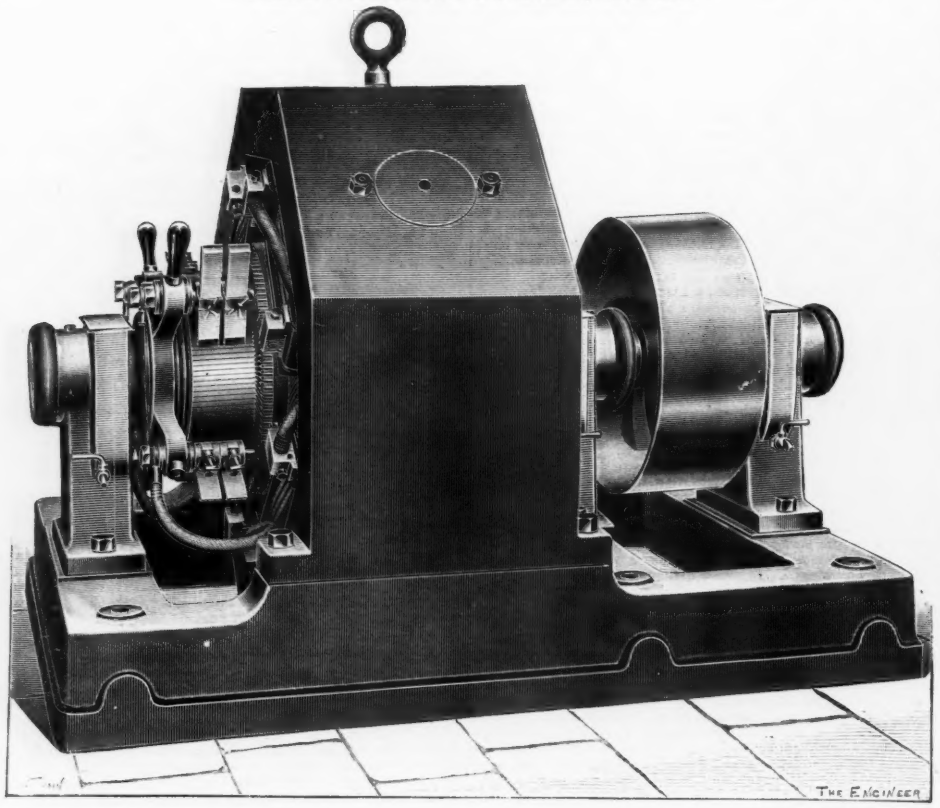
A NEW BOILER GAUGE.—About ten years ago a gauge which would indicate a pressure of 100 lb. to the square inch was considered quite sufficient for the purpose of testing boilers, as at that time few vessels in the Navy had boilers which could record a working pressure of 50 lb. The recent rapid development in propelling machinery and the introduction of water-tube boilers has necessitated the manufacture of boilers capable of maintaining a working pressure of 350 lb. to the square inch, and to ensure safety such boilers are subjected to a pressure test considerably in excess of what they are actually expected to work at. The test gauges hitherto used have now been found altogether inadequate, and in order to meet the requirements of existing boilers and to provide for further development in high-pressure boilers, the Admiralty have, says the *Naval and Military Record*, decided to introduce a new type of test gauge, which will be capable of recording with the greatest accuracy any pressure up to a maximum of 1000 lb. to the square inch.

THE MANCHESTER STEAM USERS' ASSOCIATION.—We have received from the offices of this Association a memorandum read by the chief engineer, Mr. C. E. Stromeyer, at the annual meeting of the members, held on April 5th last. Besides containing "Advice to Boiler Attendants," and a few practical remarks on the best method of cleaning boilers and economisers, fuller explanations on the injury caused to boilers by incrustation and grease are given, and an appeal is made to steam users to spare their boilers by using less oil in their cylinders. The memorandum also contains a short review of the life of the late chief engineer, Mr. Lavington E. Fletcher, and his numerous friends all over the country will be interested in having a few particulars of his career, and in hearing of the high estimation in which his services to steam users and engineers are held. Reference to the average cost of explosions distributed over the entire number of boilers in the United Kingdom will be found, the calculation being made in view of the increased liabilities imposed upon factory owners by the Workmen's Compensation Act which has just come into force.

THE GREAT WESTERN RAILWAY COMPANY.—A special general meeting was held on Monday, at Paddington Station, for the purpose of considering a Bill to authorise the construction by the Fishguard and Rosslare Railways and Harbour Company of new railways from Waterford to Rosslare, and the acquisition by the company of the undertakings of the Fermoy and Lismore and the Waterford, Dungarvan, and Lismore Railway companies, to confer running powers over certain railways, to extend the time for completion of works authorised by the Fishguard Bay Railway and Pier Act, 1893, and for other purposes. The chairman, Earl Cawdor, said it would be remembered that in February last the board received the sanction of the proprietors to proceed with certain Bills affecting the districts now in question. One of the Bills provided for the transfer to this company and the Great Southern and Western Railway Company of the undertakings of the Waterford, Dungarvan, and Lismore and the Fermoy and Lismore Railway companies, and the other for a subscription by this company to a bridge over the river Suir, authorised by the Dublin, Wicklow, and Wexford Railway Company's Act, 1897. The reason for the changes which made it necessary for the board to come before the proprietors on this occasion he thought he could best explain to them in the terms of the statement laid before the Standing Orders Committee, which were as follows:—"The Great Western and Great Southern and Western Railway companies, being desirous of opening an improved cross-Channel service for developing the traffic between the south and south-west of Ireland and London and the Great Western system in England, introduced in the present session of Parliament a Bill for empowering them to acquire the undertakings of the Waterford, Dungarvan, and Lismore and Fermoy and Lismore Railway companies, and an agreement was scheduled to that Bill by which arrangements were made with the Treasury, as mortgagees, for the payment to them of a sum of £93,000 for the purchase of the Waterford and Dungarvan undertaking. This agreement was, however, conditional upon an arrangement being made by the two companies with the Duke of Devonshire with regard to the Fermoy and Lismore Railway, of which his Grace is practically the owner, but at that time the Duke had not finally decided to enter into such an arrangement. The Fishguard and Rosslare Railways and Harbours Company was formed for the purpose of constructing a harbour at Fishguard, which was the original terminus of the Great Western Railway, and from which that railway formed the best route to London and the whole of the Great Western system, and for the establishment of a short steamboat route between Fishguard and the harbour of Rosslare, which they had acquired from the Government; and in connection with this object the company introduced a Bill into Parliament in the present session for making new railways between Waterford and Rosslare and between Cork and Fermoy, and also for acquiring the undertakings of the Waterford and Dungarvan and Fermoy and Lismore companies. Owing to the difficulty which those interested in the Fishguard and Rosslare undertaking anticipated in carrying out effectively a scheme of so much magnitude and importance, they opened negotiations with the Great Western Company, with the result that the Bill promoted by the Great Western and Great Southern and Western companies was abandoned, and the control of the Bill promoted by the Fishguard and Rosslare Company, including the powers therein of acquiring the undertakings of the Waterford and Dungarvan and Fermoy and Lismore companies, became practically vested in them, with the additional advantage of securing a short sea route *vid* Fishguard and Rosslare." Continuing, the chairman remarked that the board believed that the present scheme would carry out the object they had in view in a more effective manner than that submitted in February last. By the Bill they were seeking powers to make a line from Rosslare to Waterford and across the river Suir to Cork, giving them access to the west of Ireland. He concluded by moving a resolution approving the Bill, which was agreed to unanimously. A resolution was also passed approving the clauses which have been introduced into the Bill giving the company power to subscribe a sum not exceeding £250,000 for the purposes of the Bill, and to apply their capital to such subscription.—*Times*.

## FOUR-POLE SLOTTED DRUM DYNAMO

MESSRS. J. P. HALL AND CO., OLDHAM, ENGINEERS

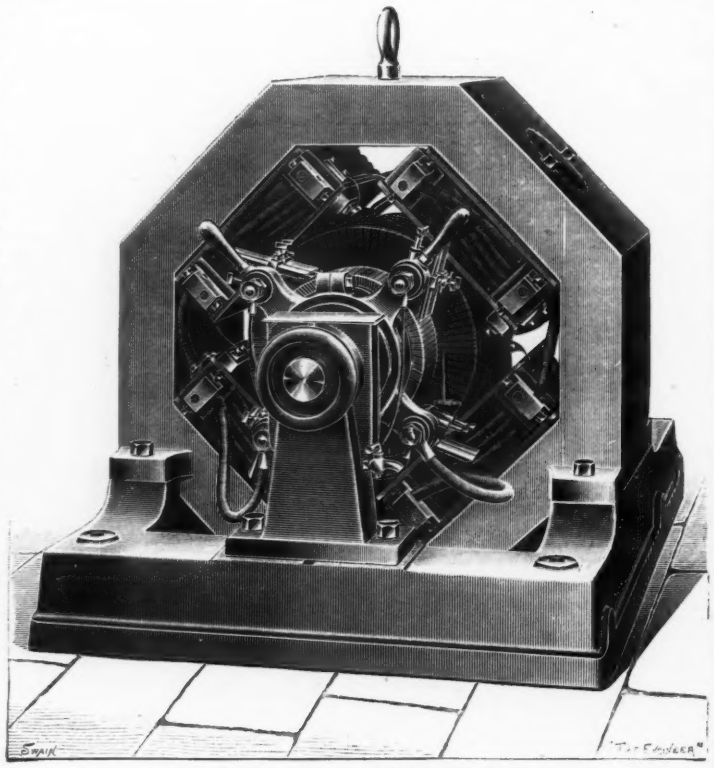



FOUR-POLE DYNAMO.

WE illustrate a dynamo of the four-pole type, with a slotted drum-wound armature. This is a standard type of the makers, Messrs. J. P. Hall and Co., of Oldham. The magnetic circuit consists of a heavy cast iron yoke; the magnets of special cast steel, having circular ends fitted into bored holes in the yoke. The magnets are compound wound, having a rising characteristic. The windings are carried on formers with gun-metal flanges.

The armature is of the four-circuit, single-wound, slotted drum type, the conductors being insulated copper bars, with end connections of the helical type. The armature core is arranged with internal ventilation, the core discs fitting on a strong steel shaft, and is positively driven, the slots being machined out after the core is built. The commutator is 11½in. diameter, having hard drawn copper bars insulated with mica. There are four sets of copper gauze brushes, those of similar sign being cross connected, and they work free from sparking with all loads without change of position.

The armature clearance is small, the efficiency high, and we understand that the heating is but slight, viz., about 50 deg. Fah. increase after six hours with full load. The electrical losses due to resistance are about 1·10 per cent. in the armature, 1·10 per cent. in the shunt, and ·50 per cent. in the series at full load, or equal to an electrical efficiency of 97·2 per cent. The output is 250 ampères at 110 volts at 550 revolutions per minute. The bearings are of the ring lubrication type. The armature weighs 878 lb., and the complete machine 47 cwt.



FRONT VIEW OF HALL'S DYNAMO

This firm have a considerable number of this class of machine in hand, varying in size from the example shown to some of 72 kilowatt, and a similar class, but of the six-pole type, up to 110 kilowatt, also a considerable number of four-pole enclosed motors of from 10-horse power at 500 revolutions to 50-horse power at the same speed.

## QUICK-FIRE GUNS FOR ARTILLERY IN THE FIELD.

IN the unavoidable absence of the Duke of Connaught, General Maurice presided at a discussion in the United Service Institution, Whitehall, on July 16th, on the subject of the annual gold medal essays of the Royal Artillery Institution, namely, the advantages and disadvantages of quick-fire guns in the field. These essays were by Major Elmslie, Captains Montgomery and Barlow, and Lieut. Buckle. In the discussion Major Jeffreys, Lord Charles Beresford, General Richardson, Sir George Clarke, Lieut. Dawson, R.A., Lieut. Wilson, and Colonel Hale took part. We do not propose to give a summary of what each speaker said, but may say at once that all were in favour of the introduction of quick-fire pieces in our field equipment, which indeed was declared to be inevitable sooner or later. It is desirable to recognise this and lose no time, for not only is the advantage of quick fire established, but also so thoroughly recognised as a practical need on the Continent that Germany and France have each already about 150 quick-fire field guns issued for service. There are, of course, questions which have to be settled not only in matters of detail, but on leading features; for example, whether, as pointed out by Sir George Clarke, a full recoil of, say, 33in., and spring recovery should be adopted, or a more complete check, or again, whether the gun should be kept in one with the limber, or on the other hand, the gun and forty rounds should be mounted on one pair of wheels, with a pole acting as the trail. There are difficulties besetting each system. Thus, it is difficult to check the recoil without causing jump. Four wheels make it difficult to change the direction of fire. It is best, perhaps, to deal at once with what appears to be the requirements of quick-fire field guns and the elements necessary to success. Lord Charles Beresford seemed to assume that because quick-fire had come into the Navy it must do so in the field. Reasoning very broadly, this might follow; but such a conclusion assumes the overcoming of difficulties which belong to the field, and have no existence on board ship. We have long held what we put forward in our report on Gruson's Magdeburg trials of 1890, namely, that the first essential to quick-fire is to secure the gun being each time placed in the same position as it occupied the previous round without relaying, because if it is necessary to relay the piece it may nearly as well be reloaded in the ordinary way. We do not, however, push this to an extreme. If sights are provided on the carriage clear of recoil action, so that the man who lays the gun is enabled to keep his eyes on the line of sight and object throughout, it is possible to deal rapidly with a little displacement while the gun is being loaded; but, broadly speaking, for efficient quick fire the eye should never leave the line of sight, and correction of aim rather than fresh aim should be the work of pointing. On pedestal and other sea service mountings this is easily arranged, the recoil and recovery of the gun taking place on a fixed base of some kind; but in the field it is very difficult to prevent such movement of the carriage as interferes with this. A spade which is driven by recoil into the ground is a favourable but rough device. If fixed in the trail, as in the first French carriage at Chicago, the gun must suffer great disturbance, and any desired change of direction laterally becomes awkward. If the spade depends from a middle point near the axletree, as in an Elswick pattern illustrated by us some years since, a much better result is obtained. Still, it is a little rough, so that there is a natural tendency to lighten the projectile and diminish the strain of recoil at some expense of energy. An objection also exists to metal cartridges as increasing weight and causing trouble in the field, so that altogether our authorities might with consistency refuse to adopt quick-fire pieces in the field so long as the recoil was not sufficiently controlled and metal cases were necessary, and yet adopt quick fire as soon as the necessary rapidity of laying is provided for, and means have been found of dispensing with metal cases. Next follows the question of weight and character of projectile. Our own artillery have probably developed shrapnel fire to a greater extent than most of our neighbours, if not all, and we have adopted shrapnel as our sole projectile for our ordinary field guns, so that an effort is sure to be made to keep the shrapnel for field service; but there is a difficulty in preparing fuzes with sufficient rapidity. The fact is, that if guns fire against artillery or any compact mark, common shells and percussion fuzes would probably be as good a projectile as could be devised. A man keeping his eye on the line of sight, and directing a stream of shells with percussion fuzes, would probably have a great advantage over an adversary firing shrapnel more slowly. On the other hand, it may be questioned if common shells with percussion fuses could ever give as good results against infantry in open formation as well-directed shrapnel. The former would, as a rule, nibble them away in spots, the latter would sweep them off. One or two suggestions were made as to new devices for the rapid setting of fuzes, and this is a subject which deserves to be pursued, but which should not delay the adoption of quick fire for the field.

Other necessities were noticed, such as the arrangement of sights, which should not suffer from the shock of recoil; the supply of a sufficient quantity of projectiles to meet new requirements; and the establishment of a more special and well-trained body of gun layers. As to the actual rate of discharge, while the very modest estimate of three rounds per minute was mentioned in the essays as a minimum, there was abundant evidence, according to Lieutenant Dawson and others, that at least ten or fifteen rounds could be fired with new special arrangements, so far as breech action was concerned.

General Maurice referred to the use of quick fire in recent actions in the Soudan, especially to the occasion when a small body of cavalry sent out on a reconnaissance owed their preservation to the fact that a battery of quick-fire guns brought their fire to bear on a large hostile body of cavalry with such effect as to prevent their forming up so as to charge. The use of quick fire in the American and Spanish war was referred to, and fairly so, because although it was in naval warfare, yet so soon as we decide that quick fire is practicable in the field, any evidence as to its good effect under any conditions carries weight, and we know that the Americans have dwelt on the need of more quick-fire guns than they at present possess. England took the lead in introducing quick fire in our naval armaments, and we trust that we shall not allow ourselves to be left behind in its adoption in the field.

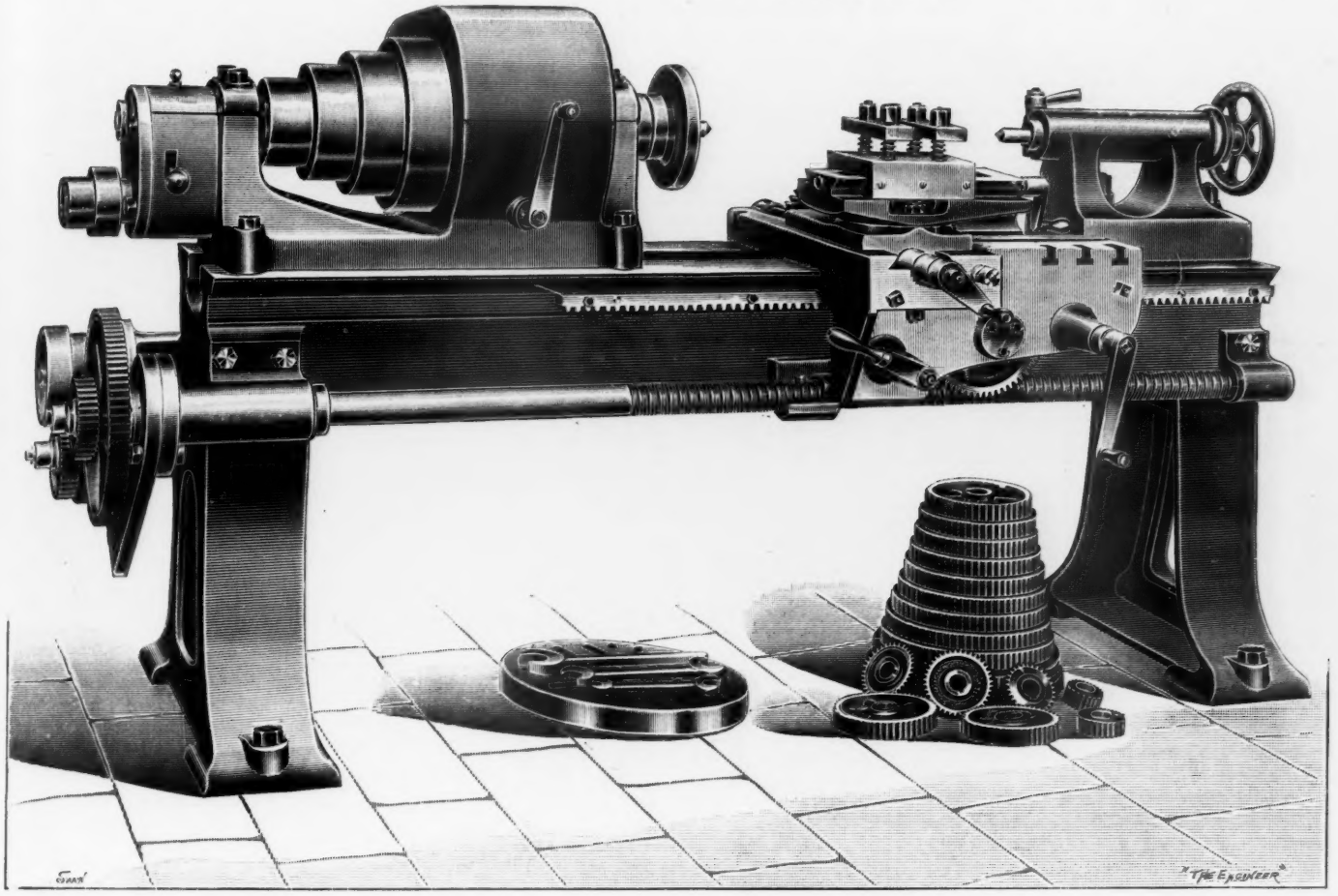
## THE INTERNATIONAL CONGRESS ON NAVIGATION.

THE seventh International Congress on Navigation is to commence at Brussels on the 24th of this month. Twenty Governments have accepted the invitation of the Belgian Minister of Foreign Affairs to take part in the Congress, and will be represented by 106 delegates. This ministry will be represented by Sir James Ferguson, M.P., and Mr. John Clarke Hawkshaw, Mem. Council Inst. C.E. The number of members who have already intimated their intention of attending the Congress exceeds 900, and it is anticipated that this number will be considerably increased. Seventy papers dealing with the subjects contained in five sections into which the Congress is divided have been sent in; of these only five are from this country. Mr. E. D. Marten has contributed two papers—one on the "Utilisation of the Fall of Water at Weirs as a Motive Force," and the other on the "Raising of Existing Weirs;" Mr. Vernon Harcourt on "A Formulary of the Characteristic Particulars about a Tidal River;" Mr. W. H. Hunter on the "Means of Consolidation of Ship Canal Banks;" and Mr. W. A. Wheeler on the "Use of Sand Pump Dredgers for the Improvement of Tidal Channels." Excursions have been arranged to Bruges, Heyst, and Ostend on one day; to Antwerp on another; and to Liége-Seraing at the conclusion of the Congress. The members are invited to receptions given by the Minister of Public Works; by the President of the Patronage Committee; and by the Municipalities of Brussels, and Bruges, and Antwerp. The countries represented at the Congress, besides this country and the United States, are Belgium, France, Germany, Russia, the Netherlands, Roumania, Switzerland, Hungary, the European Commission of the Danube, Denmark, Italy, Japan, Sweden, Norway, Portugal, and Spain.

ELECTRICAL PATENTS.—We are informed by the secretary of the Institution of Electrical Engineers that arrangements have been made with the Patent-office under which there will be placed on the library table at the Institution every Monday morning a copy of each electrical patent specification published during the preceding week. The specifications will remain on the table for three weeks, and will then be filed.

# STANDARD LATHE

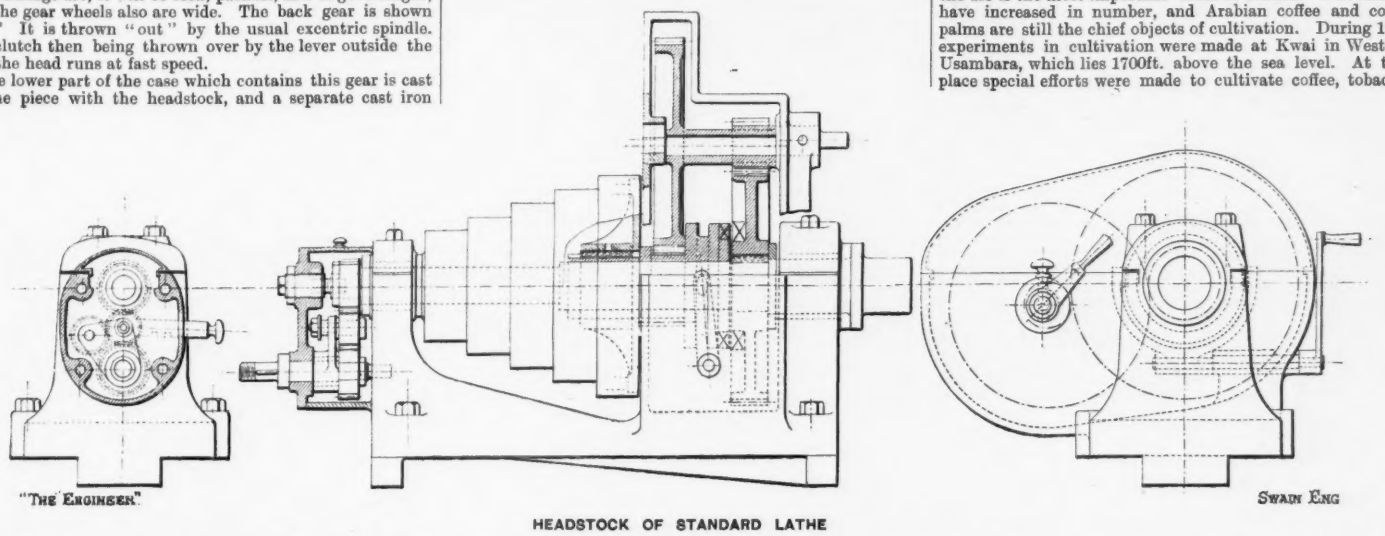
MILEY'S MACHINE TOOL COMPANY, LIMITED, KEIGHLEY, ENGINEERS



## STANDARD LATHE.

In the lathe illustrated above by a photograph and below by three sectional drawings, the chief features to be observed are the cases covering the gears; but besides this the method of throwing the back gear in by a clutch, which is rapidly replacing the bolt-and-slot method, may also be noticed. The general arrangement of the headstock will be understood from the central figure; but it must be observed that the back gear is only shown on top for convenience; its true position is at the side, as usual, as shown in the third figure. The bearings are, it will be seen, parallel, and of good length, and the gear wheels also are wide. The back gear is shown "in." It is thrown "out" by the usual excentric spindle. The clutch then being thrown over by the lever outside the case the head runs at fast speed.

The lower part of the case which contains this gear is cast in one piece with the headstock, and a separate cast iron cover is provided. The gear is therefore easily kept clean, and can work in a bath of oil if desired. The arrangement for the change gear is somewhat similar. Besides the advantages of cleanliness and oil bath, the noise of the gearing is very much reduced—a point of no little importance in a turnery where many lathes are at work. The perspective engraving illustrates the 9½in. centres lathe, and the headstock outline is that of the 12½in. lathe. The bearings in the headstock are of gun-metal, and the clutch with its sheave and spur wheel are sometimes made of steel, but generally of cast iron. The driving gear in the headstock in every size of lathe is machine cut, and the reversing wheels at the end are of steel, and also machine cut. No doubt it will be noticed from the engraving that the back shaft is driven by cone pulleys of different sizes; these are interchangeable, so that we can have the smaller driving the larger, or *vice versâ*, thus giving a large range of feeds. For a traverse of eight per inch and coarser, such as shipbuilders require, the back shaft is arranged so that it can be driven by the change wheels supplied for screw-cutting. Lathes of all sizes, of this kind, up to 30in. centres, are now being made to this design by Messrs. Miley's Machine Tool Company, Limited, Worthside Works, Keighley, Yorkshire.




HEADSTOCK OF STANDARD LATHE

## THE GERMAN PROTECTORATES IN AFRICA.

Some interesting facts concerning the development of the German Protectorates in Africa during the past year are to be found in a "Blue-book" which has been lately laid before the Reichstag. In the Togo Protectorate there were altogether 107 Europeans, dwelling mostly in Lome and Little-Popo. The former settlement is gradually attracting to itself more Europeans than is the latter, while the latter contains 1252 huts and 6574 persons. During the year eight Europeans died, three of them from blackwater fever, and one from malaria. As hitherto, the chief productions are oil palms, cocoa palms, rubber trees, and coffee. The value of the year's exports amounted to nearly £65,000, but the continuous drought during the past autumn had a very bad effect on the exports, and in the exportation of palm oil and palm nuts there is a great decrease. Nevertheless, from a general point of view, this Protectorate shows a gratifying progress. In the Cameroon Protectorate there were 253 European residents, and of these 181 were German. In 1896 the figures were 236 and 161 respectively. This Protectorate has, during 1897, developed greatly by the impetus given to the formation of plantations, and the cultivation of cocoa and coffee has been specially fostered. Besides this the export trade embraces palm oil, palm nuts, rubber, ivory, ebony, nuts, tobacco, and timber. The exports for the year ending June 30th, 1897, amounted to £185,000, or £11,250 less than in the preceding year. This difference is attributed to the fact that the prices of the commodities are now fixed in Cameroon instead of in the European markets, as was formerly the case. The imports for the same period amounted to £295,000, or £17,500 less than for the former year. The Customs receipts also show a decrease of £400 on their total of £23,050. This colony may be said to have reached a turning point, since the development of plantations must increase its trade.

In German East Africa there were 922 Europeans, of whom 678 were Germans. In the not far distant future this colony will come to the front in agriculture, although the antiquated methods of the natives are but slowly giving way before the more enlightened system of the settlers. The measures taken in order to introduce more suitable implements have so far failed. The complaints as to the ravages committed have been much less than in the preceding year. The condition of the cattle has improved, and, after the ox, the ass is the most important beast of burden. Plantations have increased in number, and Arabian coffee and cocoa palms are still the chief objects of cultivation. During 1896 experiments in cultivation were made at Kwai in Western Usambara, which lies 1700ft. above the sea level. At this place special efforts were made to cultivate coffee, tobacco, vegetables, and European cereals, and 180 acres were carefully ploughed and harrowed for the cereals. It is said that coal has been found in two places. Communication upon the Usambara Railway has on two occasions been interrupted in consequence of the bursting of dams, owing to heavy rains. The Customs receipts for the year exceeded by £5000 the estimate of £67,500.

In German South-West Africa there were 2628 Europeans, and of these 1221 were Germans, living mostly in the Windhock district. This Protectorate has suffered very much from the after effects of the cattle plague. Agriculture continues to make progress, and horticulture and arboriculture are flourishing, especially in Windhock. Fruit trees, vines, acacias, &c., have been planted out in great numbers. As to cattle, the breeding of horses seems to have a great future before it, more especially in the western and southern parts. In sheep breeding no real progress is to be recorded, but the angora gives promise of development, and the same may be said of swine. Trade relations between this Protectorate and Germany are continually increasing, while those with Cape Town are ever decreasing. The Customs receipts for the four months ending March 31st, 1897, amounted to about £11,000. The Blue-book contains much valuable information.

## LETTERS TO THE EDITOR.

*(We do not hold ourselves responsible for the opinions of our correspondents.)*

### RAILWAY SPEEDS.

SIR,—I have read with much interest Mr. Rous-Marten's articles on the July train services. I am at a loss to understand why he regrets the very moderate reduction in speed which he describes.

I would ask practical men what possible difference it can make to them whether a train takes four hours in running from Euston to Liverpool, let us say, or 4¼ hours? To by far the larger proportion of the passengers it is a matter of perfect indifference. The third-class passenger is the person who supports our railways and pays our dividends, and it would be a bold man who would assert that the extra quarter of an hour is of the smallest importance to him. There are, of course, conditions under which even five minutes are of value, but they do not obtain on runs between large towns on the main lines. I can call to mind a cross-country train which some years ago had to connect two main-line trains, and in order that this should be done with success the train was allowed sixteen minutes to run fourteen miles, and the work was done daily. Here an extreme speed was really necessary. But, as I have already said, what difference can it make whether I am ten minutes more or less than usual in getting to Cardiff or Exeter from London?

The desire to travel at a great pace has no commercial foundation whatever. It arises from nothing but a seeking after the mental pleasure of moving quickly. If, instead of goading the railway companies to travel at high speeds, a determined effort was made to ensure punctuality, it would be much more to the purpose, and we should in the long run do all our railway travelling with much less waste of time and temper.

In the race "to get there first," we sacrifice a great deal of comfort and run many risks. The hurry and confusion when a train is in a station; the wild bolting of buns, and the choking struggle with scalding tea; the agonised doubt, first as to whether you will get any beer or not, and then the apparent certainty that you will not get your proper change; the frantic rushing up and down a platform in search of a seat; the mislaying of luggage, children, dogs, umbrellas—everything, in short, that can be mislaid; the cruel separation of wives and husbands, each travelling in a different train, and neither of them in the right one; the giving of florins to porters in mistake for pennies; the thrusting at the last moment of elderly ladies who abominate tobacco into smoking carriages already full of men who abominate elderly ladies; the paying of cabmen much more than their legal fare, because you have not time to argue the point, and have no coin smaller than a half-crown; the mixing up of yourself and half a dozen other people with your bicycle; the tendency to swear only suppressed by lack of breath; all these and a hundred other troubles would be avoided if a little more time were allowed at the stations where the train stops. What we want is not a reduction in the time of making a journey, but a certainty that the train will arrive precisely at the hour set forth in the companies' bills, and more peace and comfort throughout the whole run. Sir, an extra quarter of an hour devoted to securing these things on a run to Liverpool or Edinburgh would be well worth the outlay. Not to make this letter too long, may I conclude by paraphrasing the words of the little boy who, having been taught with some trouble the names of four of them, turned to his teacher and said, "What is supposed to be the use of continents?" and ask Mr. Rous-Marten what is supposed to be the use of the few minutes which may be saved by goading everyone connected with a railway—travellers and porters alike—to distraction.

Westminster, July 19th. FESTINA LENTE.

### THE FLASH POINT.

SIR,—In your number of July 1st you publish an article on the flash point, which I think puts the matter neither fairly nor truly. Perhaps, with your usual courtesy, you will allow me to discuss one point—it is fundamental to a proper discussion of the question. If an oil flashes at 73 deg., is there any danger of explosion or fire at 73 deg., or does danger begin only at 100 deg.? Col. Majendie in 1894 gave the opinion that there was little danger till such an oil was heated to 100 deg., and said that at 83 deg. there was no danger of explosion in a barrel. This was a dreadful error for a Government expert who had charge of legislation to make. Experiments have definitely proved that when in large quantities an oil can, under certain ordinary circumstances, give a dangerous explosion at its Abel flash point, and for large quantities the flashing point Abel is also the firing point, and these facts any chemist can test for himself.

In recent reports, however, Col. Majendie detailed many accidents, which proved that he saw clearly, and wished others to see, that ordinary petroleum gave off vapours in quantity at the ordinary temperatures of summer. He described how in shops where the petroleum was in open pails the vapours went to some distance to be ignited by a light, and when a five-gallon drum was spilled in a shop, and a lighted match let fall by a woman, the vapours went off explosively, burning the woman severely and gutting the shop. The remarkable thing, however, was that a "tongue of flame swept through the shop into the passage beyond, and caught a child, fatally burning it." The danger of ordinary petroleum is the great volumes of vapour it is capable of evolving at ordinary temperatures above its flash point, and the sudden uncontrollable start of any fire originated by it.

It is an acknowledged fact then, that an oil a few degrees above the flashing point by the Abel test is a source of great danger if a light can reach its vapours, and under its flash point a few degrees there is no ignitable vapour present. An ordinary summer temperature is 83 deg., and very hot days it reaches 93 deg. in the shade; and even in winter 73 deg. is a common temperature in kitchens, where the oil can is often kept. Ordinary petroleum often originates fires by sending out vapours to lights in the neighbourhood. Oil of 105 deg. flash cannot originate a fire in this way; it has to be heated by some external source to 105, or over it, before it can take part in a fire or cause an explosion. In a climate, therefore, where houses are often between 73 deg. and 93 deg., oil of 73 deg. is incomparably more dangerous than oil of 100 deg. or 105 deg. Fah.

The Scotch manufacturers can boast that during their existence of nearly fifty years they never put naphtha into the burning oil, although the law allowed it, and the cheapness of naphtha for many years made it a great temptation. They adopted 100 deg. Abel as standard for themselves, and as a consequence have had no lamp fatalities. They and the Russians have the naphtha to dispose of just like the Americans. The State of Iowa, with a population of considerably over two millions, consuming an average of 7½ gallons of petroleum per head, and having a standard of 105 Elliot close cup, has had not one lamp fatality during fourteen years (L. F. Andrews, of Iowa State Board of Health, in *Iowa State Register*, March 18th, 1898). London, with a population of over four millions, consuming only one-fifth gallon per head, with its 73 deg. standard, has had 189 deaths and 269 injured during the last seven years (London County Council Report, Public Control Department, 1897).

There is a common tendency to refer the Abel test to its equivalent in the open test. Your article asks what is the equivalent of 100 deg. Abel? The Abel test gives a point whose relation to danger is easily determined. The open test gives no point, but a range of some width. Besides, the 100 deg. open test was never by experiment found to be safe; it was never tried. Our first Act in 1862 defines "Petroleum for the purposes of this Act shall include any product thereof that gives off inflammable vapour at a temperature of less than 100 deg"—a very good definition of the aim of all our legislation. Oil of 100 deg. Abel test gives off inflammable vapour at 100 deg., and 73 deg. oil gives off inflammable vapour at 73 deg., as the test itself proves.

In 1867 a Parliamentary Committee, after hearing evidence, recommended 110 deg. as standard. Correct methods of testing not being generally known, or agreed on then, three chemists, Abel, Attfield, and Letheby, were appointed to draw up the schedule describing the method of testing. They tried a half-filled cup, and reported that if this were rigidly adhered to the standard might be left at 100 deg. But the petroleum folk put pressure on the Home-office to get their open test into the Bill. This test gives a point nearly 30 deg. higher than the truth, or the half-filled cup, or the Abel test, as the vapour gets dissipated during the testing. The open test was, however, inserted into the 1868 Act at the last moment, and allowed to stay, and of course the fatalities which caused the legislation continued as before. The chairman of the Committee protested, and Dr. Attfield also protested. The Under Secretary assured the House that the recommendations of the three chemists "had been adopted in their entirety"—a tremendous blunder. Since 1868 100 deg. open test, or its equivalent, has been the standard; but the aim and intention of Parliament was a standard of 100 deg., by the half-filled cup of the three chemists, and that, and not the equivalent of the indefinite open test 100 deg., should have been the Abel standard adopted in 1879, when the Abel test was adopted. The equivalent of the Abel test and the test of the three chemists can be easily determined by experiment anew at any time, and has no connection with old errors. An oil of 73 deg. by the Abel test can with great skill be made to flash in the half-filled cup a degree or two under the Abel point, with less skill a degree or two above it; but only by dishonest manipulation can it be got far from it. We have matter of fact here for foundation, and not mere opinion. Any chemist can test the point. The only use of the open test is to mislead.

As to the contradictory science put before the Committee, the Scotch chemists have said the same thing for the last forty years, and their position is the same as that of every independent scientific man who has investigated the matter; there is no exception that I ever heard of. Professors Chandler and Engler in their published investigations agreed with all others; but before the Committee they expressed opinions in contradiction to their scientific work. The matter has been studied by Mendeleef, Victor Meyer, and about a score of other eminent chemists. For storage and carriage a flash point is demanded a few degrees above the summer temperature of the climate; for use in lamps, a few degrees above the highest temperature found in the ordinary lamps in use in the country among the poor.

Broxburn, July 18th. D. R. STEUART, F.I.C.

### WATER-TIGHT DOORS TO BULKHEADS.

SIR,—The question of the design and efficiency of water-tight doors for bulkheads and bunkers has on special occasions exercised the minds of naval architects and others for a long time past. Frequent disasters at sea, up to the latest appalling calamity which resulted in the loss of the French liner La Bourgogne, conclusively prove that the problem of the efficiency of water-tight bulkheads is one that should be exhaustively treated and decisively dealt with by the marine registry societies and the naval Powers of the world.

In the light of the most startling cases of losses at sea during the last twenty-five years, it must be admitted that the bulk of these disasters, and the consequent loss of life and property recorded, arises from causes that can readily and effectually be provided against, and are consequently easily preventable. For instance, the loss of life and property due to collisions at sea is the most fruitful cause of the greatest mishaps that occur afloat. Collisions, of course, vary in their character. Very often vessels run into each other during dense fogs, as in the case of the La Bourgogne and the Cromartyshire; at other times they collide in the impenetrable darkness of night, and, again, not infrequently in broad daylight. Finally, we have collisions with icebergs—which are a source of great peril to record-breaking mail steamers as well as to ordinary navigation—and with the mysterious sunken wreck, the latter, more often than not, being credited to the fertile imagination of those responsible for the mishap. But whether an iron or steel ship collides with a sunken wreck or a sea serpent, an iceberg or rock, another ship or heavy floating wreckage, the result is the same.

Damage is sustained by one or both of the ships so colliding, which renders it necessary for their safety, and for the safety of the valuable lives on board these ships, first, that the water-tight bulkheads should be strong and sound, and at the same time be spaced within limited intervals apart; and, secondly, that the doors fitted to these bulkheads should be so well devised and skilfully operated that they may be instantaneously and effectively closed on the first approach of danger, and in the direct place of the impact of damage received.

So far back as November, 1875, Sir Nathaniel Barnaby, in his report to the Controller of the Navy on the loss of the Vanguard, after collision with the Iron Duke, in referring to the water-tight doors to bulkheads, said:—"The difficulty of effectually closing one of these doors in the Vanguard, because one of these buttons was pushed round too far, shows a defect in this fitting which will be remedied by a general order."

From statements made at a meeting of the Institution of Naval Architects held in March, 1896, over twenty years after the foregoing report was made, it appears that, although a remedy was suggested by a general order, many serious naval disasters followed one upon the other during this period—not the least of which was the loss of the Victoria—all due to the inefficiency of the water-tight doors. One speaker at the meeting above mentioned, viz., Lord Charles Beresford, said that "the structural component parts of a modern battleship consist of a variety of compromises, and that water-tight doors in particular form one of the compromises, by virtue of which the safety of the ship is seriously endangered." At the same meeting Colonel N. Soliani, Director of Naval Construction of the Italian Royal Navy, also said:—"It is quite apparent that the arrangement of water-tight doors on which the efficiency of the bulkheads depends are far from satisfactory, as evidenced by many sad disasters."

Three months after these statements were made by such eminent authorities, Mr. Benjamin Martell, the chief shipbuilding surveyor of Lloyd's Registry of British and Foreign Shipping, in speaking on the general inefficiency of doors to water-tight bulkheads at the midsummer meeting of the Institution of Naval Architects held in Germany, said:—"It must be admitted that too little attention has been given to this point, and although excellent designs have been before the public for a long time, old-fashioned plans are generally adopted both in war and mercantile vessels. In the latter case it is not a matter of so much surprise, as competition being so keen, extra cost in adopting new plans is generally fatal."

From the time of the sinking of H.M.S. Vanguard, nearly twenty-five years ago, up to the rapid sinking of the French liner La Bourgogne, it is an acknowledged and undeniable fact that many valuable lives and millions of pounds worth of property have been lost at sea owing to the inefficient nature and worthless character of the obsolete doors fitted to the openings required in the water-tight bulkheads. This deplorable fact almost passes belief, but it is unfortunately only too true that battleships and mercantile vessels alike, with their officers, passengers, and crews, are sacrificed in the most reckless and suicidal manner conceivable, when a little departmental consideration on the one hand, and a small increased outlay on the other hand in fitting improved water-tight doors placed at the disposal of the Government and mercantile shipowners in each instance, would have surely prevented many sad and appalling catastrophes. The reason why such a small appliance, which is, however, of great vital importance to the safety of ships, is so utterly neglected, is due to the lack of responsibility in the administrative departments of naval Powers and the marine registry and classification societies, as to the efficiency or non-efficiency of the water-tight doors fitted to the bulkheads in the ships they pass and class.

So far as the water-tight sub-division of ships is concerned, the case lies in a nutshell. What is needed to ensure the greatest margin of safety for ships against foundering from the effects of a collision of any kind, or from the damage caused by the impact of shot and shell or collision, is that, in addition to ships being fitted with a sufficient number of bulkheads of ample strength to withstand the stress caused by any compartment being filled with water—and bunker doors are invariably open—they should be furnished with efficient water-tight doors of a well-defined type and character. Although all Governments and ship-registration societies have long since arrived at conclusions, and laid down hard-and-fast rules defining the number, disposition, and strength of bulkheads for all classes of ships, so that in the event of a certain compartment or number of compartments being flooded, the damaged ship will still float if the bulkhead is preserved intact; yet no naval Power or marine registry society has as yet undertaken the duty of dealing efficiently and decisively with the serious need of improved water-tight doors, having simple and sure modes for operating them instantaneously. It is well known that vessels are built and building of 12,000 tons deadweight, and what is frequently the case, owing to the mode of loading, the bulkheads get twisted, and it often happens that passenger steamers after being laden cannot by any means close the present obsolete system of doors. In many instances these first-class passenger steamers are practically unseaworthy; and without doubt not any of the doors fitted to coal bunkers can be closed with coal on both sides, to say nothing of the great pressure exerted by the water coming in against the door and increasing in volume as the vessel sinks deeper and deeper till suddenly disappearing.

It is beyond the resources of man to expect sailors, however brave, to go below and stand by screwing a door down with the ship gradually sinking under them, with a list that practically prohibits any human being keeping his balance, much less trying effectually to save life and property. J. C.

Philpot-lane, July 18th.

### MARINE BOILER FURNACES.

SIR,—I send you herewith a few figures representing sections for marine boiler furnaces. Some of them are well known, others are purely academic. To engineers, marine boiler furnaces frequently cause much trouble, and expense to shipowners. The trouble arises from quite a variety of causes, the principal of which is dirt; expense follows as a natural consequence.

It is generally admitted that that furnace is the best which, whilst providing for longitudinal elasticity, resists the greatest collapsing stress. It is very desirable, too, although not absolutely necessary, that the material of the section be of a uniform actual thickness throughout.

In looking over these sections it would seem difficult to select one that would best fulfil the above conditions, and would resolve itself ultimately into a question of taste, or perhaps of cost. One can be guided in a selection by Board of Trade tests, or by good records which any one section may have had.

These figures to which I refer have been measured, and the results tabulated. In column A are areas each measured over a

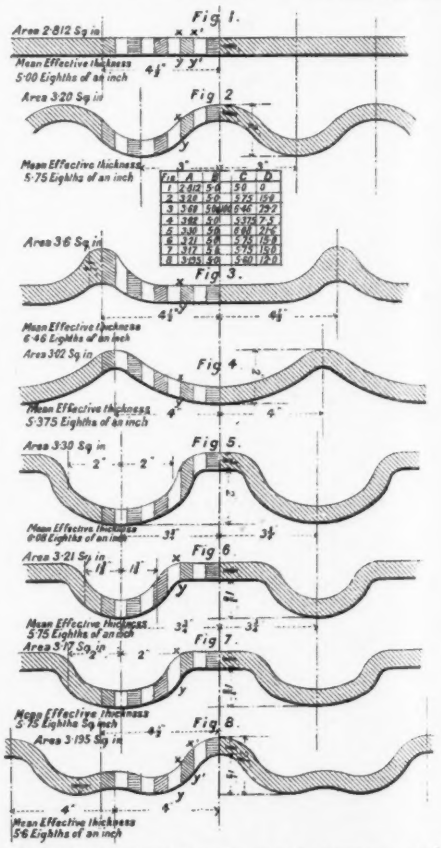


Fig 1.
Area 2·812 Sq in
Mean Effective thickness 5·00 Eighths of an inch
Fig 2
Area 3·20 Sq in
Mean Effective thickness 5·75 Eighths of an inch
Fig 3.
Area 3·6 Sq in
Mean Effective thickness 6·46 Eighths of an inch
Fig 4
Area 3·02 Sq in
Mean Effective thickness 5·375 Eighths of an inch
Fig 5.
Area 3·30 Sq in
Mean Effective thickness 5·88 Eighths of an inch
Fig 6
Area 3·21 Sq in
Mean Effective thickness 5·75 Eighths of an inch
Fig 7.
Area 3·17 Sq in
Mean Effective thickness 5·75 Eighths of an inch
Fig 8.
Area 3·195 Sq in
Mean Effective thickness 5·6 Eighths of an inch

length of 4½in.; in column B are the actual thicknesses in eighths of an inch; in column C the mean effective thicknesses, also in eighths of an inch; in column D the percentage of increase of the mean effective over the actual thicknesses.

I contend that the section having the greatest mean effective thickness is the strongest section, and the best able to resist the greatest collapsing stress. But an influential engineer—and eminent authority, too—told me that this was not the right method by which to measure a furnace section. Fig. 1 is that of a plain section, and to measure its thickness, or its effective thickness, is to measure along any vertical line, say, $x\,y$, on that section. Fig. 5 is a curved section, and to measure its effective thickness is to measure along a line, say, $x\,y$, on that section. That it is right to measure along $x\,y$ on Fig. 1 will at once be admitted. Then how does it become wrong to measure along $x\,y$ on Fig. 5?

Again, suppose a complete ring $x\,x^1\,y\,y^1$ to be cut out of a furnace of Fig. 1 type; another complete ring $x\,x^1\,y\,y^1$, to be cut out of a furnace of Fig. 8 type, no mathematics are needed to show that the Fig. 8 ring would be much stronger than the ring from Fig. 1. All the sections may likewise be considered, and that section would be the strongest which could provide the greatest number of rings collectively stronger than those from Fig. 1.

Being unable to discover for myself any flaw in this method, I would be glad, with the help of criticism, that the method be shown to be right or wrong. ALEXANDER DALRYMPLE.

Hull, July 15th.

## RAILWAY MATTERS.

THE General Tramway Company, of Paris, has obtained preliminary powers for introducing electricity on its Bastille-Charenton line. It has also lately secured municipal consent to an extensive addition to its lines.

THE Paris Omnibus Company, which has a monopoly of the omnibus traffic in Paris, is about to contract a loan of £1,000,000 for the purpose of transforming its present rolling stock, and introducing motor traction.

A CONNECTING-ROD of an express locomotive belonging to the Great Western Railway Company, running between Windsor and Paddington, broke on Monday last between Ealing and Acton. The boiler was ripped open, and the driver and fireman were so badly scalded that they both succumbed to their injuries.

THE Highways Committee of Leeds Town Council have decided upon further extensions of their tramway service. Parliamentary powers have already been obtained for carrying out these extensions, and the Highways Committee only need the sanction of the Council to commence doing the work. The lines are to be bonded, so as to be suitable for electric cars.

THE best alignment that is said to have been found for a railway up the Khyber follows the course of the Khyber River to Ali Masjid, and thence along the ordinary route to Landi Kotal. Until the policy of the Government is declared it is impossible, says *Indian Engineering*, to say whether any steps will be taken to build a line, or even to make an earthwork so that the rails could be rapidly laid on an emergency.

As the result of an investigation of the operating expenses on the 136·5 miles of single road run by the Metropolitan Street Railway Company, of Kansas City, it has been found that the average cost of one kilowatt hour is 4·874 cents. The current which furnishes the power is used on about seventy-seven cars, which run on the seventy-one miles of electric lines, the remainder of the cars in Kansas City being worked by cable.

ACCORDING to information received from Calcutta, Mr. F. S. Wilde, holding the post of executive engineer in the North Cachar Hills, has been murdered by Pathans. A reward of 5000 rupees has been offered, but up to the present the murderers have remained undiscovered. Reuter's Agency is informed that Mr. F. S. Wilde was a Government executive engineer employed on the extension of the Assam-Bengal Railway now under construction.

THE remoter parts of Derbyshire are now to be opened up by light railways. One scheme is to run a narrow-gauge line between Derby and Ashbourne, which would obviate the wearisome round at present to be taken between these places. Another narrow-gauge railway is to be in the High Peak. It leaves the London and North-Western line at Doveholes, and, passing through Peak Forest to Tideswell, reaches historic Eyam, dipping down to quaint old Stoney Middleton, and then on to Calver and Calver Sough, where the Derwent is crossed; then up the valley by Froggatt to Grindleford, joining the Dore and Chinley Railway of the Midland Company at that place.

A SINGULAR accident, resulting in injury to four workmen, occurred on the Great Western Railway at Carey Bridge, near Ross, Herefordshire, on Sunday. The bridge was under repair, and a crane used for raising the girders, from some unexplained cause, fell over into the river Wye. The chain of the crane, flying back, smashed the woodwork of the bridge and injured four of the workmen. The passengers by the afternoon train from Hereford to Gloucester had to be conveyed across the river in boats, and entered the train on the opposite side of the bridge, while the passengers in the evening train for Hereford were compelled to alight on their arrival at the bridge and cross the damaged structure on planks. The bridge had been repaired by Monday morning, and the traffic was resumed.

THE International Sleeping Car and European Express Trains Company, which have concluded its contract with the Government of the Czar for the exploitation of the Trans-Siberian Railway by trains *de luxe* from Calais and Paris as far as the present terminus, Krasnoiarsk, and eventually, as soon as the railway shall be completed, to Port Arthur, announce a novel August excursion. In connection with the Nord express and other trains from London and Paris to St. Petersburg and Moscow, a train *de luxe* composed of sleeping cars, a restaurant car, and baggage car only will leave Moscow at 10 p.m. on August 5th, going to Nijni Novgorod, where a two-days' visit will be made to the famous fair. A stay of one day and a-half will be made at Kazan, the ancient capital of the kingdom of Tartary. Thence the train proceeds to Samara, over the Ural Mountains, making visits to all the principal cities and places of interest *en route*, amongst others Cheliabinsk and Tomsk, and arriving finally at Krasnoiarsk, the present terminus of the Trans-Siberian Railway. The return journey will be made *vid* Samara and Toula to Moscow, which will be reached on August 24th.

AT an extraordinary general meeting of the London, Tilbury, and Southend Railway Company recently held, a resolution approving the Bill for empowering the District Railway Company and the company to subscribe towards the capital of the Whitechapel and Bow Railway Company was carried. The chairman, in proposing the resolution, observed that the object of the Bill was to make a connection between the company's line at Bromley and the extension of the Metropolitan and District railways at Whitechapel. The Act was obtained last year by independent parties. The proposed line would be two miles and five chains long, and the authorised capital was £660,000, with borrowing powers to the amount of £220,000. The promoters approached the directors to know what this company would like to do in the matter, and after consulting the District Company, who also took a great interest in the subject, they decided to construct the projected line jointly. It would be very advantageous both to their own and to the District Company, as it would enable a physical connection to be made between their two systems, whereas, under the existing condition of things, passengers for the Tilbury Company's line had to alight at Aldgate or Mark-lane.

BY far the most important source of revenue to the Prussian Government is the railways. The net revenue has increased from £4,700,000 in 1880—81 to £21,900,000 in the estimates for 1898—99. This is partly owing to the extension of the State-owned railways. More than half of this revenue is applied to the payment of interest and sinking fund for the railway debt, so that the State derives for general purposes only £8,750,000 from the railway revenue. The expenditure has increased from £7,000,000 to £38,000,000. The report of the Prussian Finance Minister on Prussian Finances from 1890 to 1897 points out that a large proportion of this increased expenditure went to the improvement of the position of railway employés. For the increase of rolling stock the sum expended in the last seven years was 5,600,000, besides the ordinary expenditure for renewals and repairs. In the estimates for 1898—99 the sum set apart for renewals and repairs of rolling stock in the ordinary expenditure is £5,880,000. From 1890—91 to the end of 1896—97 credits to the amount of £31,488,000 have been issued for new lines, stations, &c. About 1650 miles have been opened to traffic during that period. Since 1880—81 the total receipts have increased from £12,000,000 to £55,000,000, or 361 per cent., and the expenditure from £7,000,000 to £34,000,000, an equal percentage. Comparing, however, the figures for 1880—81 with those in the estimates for 1898—99 the receipts increased at the rate of 399 per cent., and the expenditure at the rate of 421 per cent. The figures of the railway expenditure do not include a sum of about £800,000 for railway pensions, which are charged to the general account.

## NOTES AND MEMORANDA.

A GERMAN contemporary states that rubber is not impervious to acetylene gas.

THE French Société d'Encouragement has awarded the grand prize of 12,000 francs to M. Moissan for his numerous researches in chemistry; the prize of 2000 francs for the experimental study of the properties of metals and alloys to M. C. E. Guillaume; and an *encouragement* of 500 francs to M. Capredon for his work on metallurgical chemistry.

THE annual rainfall at Rivas, near the Pacific coast of Nicaragua, was 123·43in. in 1897. Rivas is about four miles to the west of Lake Nicaragua, and nearly on the line of the proposed Nicaragua Canal. Previous records ranged from 30in. to 90in. for the year. On the Atlantic side of Nicaragua, at Greytown, the annual rainfall in 1890 was 320·48in. with 274·85in. in the Deseado Valley, twelve mile inland.

AT some works in Germany a cask full of minium, or red lead, had become hardened, and in order to work up the mass again a commencement was made of breaking it into pieces, the whole being left for the night covered with a few sacks. The oxygen of the air soon acted upon the fresh fractures, raising the temperature of the mass, while reducing and igniting the resinous substances that had served to agglomerate the red lead cement, and a fire was only prevented by the fortunate arrival of the watchman.

A NEW process for the manufacture of artificial india-rubber is reported from Germany, and is said to have been successfully tried by an English company. The process consists in the oxidation of linseed oil, with the addition of prepared jute refuse, or similar hitherto worthless textile refuse, by which means a substance is produced which possesses many of the qualifications of genuine india-rubber. It is capable of being utilised in many ways, and of being manufactured into various articles hitherto made of india-rubber.

THE so-called displacements of the North Pole were lately represented graphically in the *Gothaer Mitteilungen*, and a great deal of trouble is often taken to establish these displacements by a systematic determination of latitudes. Perhaps, however, observes Professor A. de Lapparent, it would be preferable to make sure, by measurements similar to those of the Austrian Generalstab (Staff), whether this supposed displacement be not imputable to the very points of which it may be sought to determine the latitudes, because it is a decided error to regard the earth's crust as immovable.

TEXTILOID is the name given to the latest substitute for rubber, introduced by Eugene Cadaret, of Paris. It consists of resinoline and admixtures. The resinoline is said to be obtained by treating oil with three or four times its bulk of metallic carbonates, and then with nitric acid. Then follow saponification, precipitation by means of an acid, and dissolution in alcohol or ether. A hundred parts of resinoline are mixed with twenty of zinc, oxide of manganese, &c., and sixty parts of methylated spirits; after several hours the mass is kneaded for one hour or more, and finally compressed at a temperature of 80 deg. or 90 deg. Cent., under a pressure of 200 to 800 atmospheres.

THE quantity of cement mixed with pebbles or broken rock to form concrete, and of lime mixed with sand to form mortar, should be just so much as will fill up the interstices of the siliceous substances. With a deficiency of lime or cement the mortar or concrete will be too poor, so that its homogeneity will not be ensured; and too large a proportion of the binding substance will only occasion unnecessary expense without increasing the strength of the mortar or concrete. The above is a summary of some observations in the *Semaine des Constructeurs*, by M. Paul Mesnard, who gives the following directions for properly apportioning the lime or cement:—The volume of the spaces in the siliceous matter employed must first be measured, which is an operation easily performed, since it is sufficient to pour upon them in a receptacle just sufficient water to just cover their surface, and then measure the volume of water poured in.

THE report of Sir William Crookes, F.R.S., and Professor Dewar, F.R.S., on the composition and quality of daily samples of the water supplied to London for the month ended June 30th, states that, of the 182 samples of water collected by them during the month from the mains of the London water companies taking their supplies from the Thames and Lea, all were found to be clear, bright, and well filtered. The rainfall at Oxford for the month of June was again considerably below the average, the actual fall being 1·34in., the thirty years' average is 2·11in., leaving a deficiency of 0·77in. This brings the deficiency for the first six months of this year to 3·34in. During the month the London waters were of high dietetic quality. The number of microbes in the supply was generally low, with the exception that on June 6th a sudden increase of harmless microbes took place in all the companies' waters. The fact that this anomaly occurred simultaneously in all the filtered waters suggested that it was due to some general cause, which at present remains unexplained.

THE pressure attained by superheated water, observed M. Alexandrowicz to the Antwerp section of the Liége Engineers' Association, corresponds neither with Papin's experiments, nor with the tables compiled by Regnault and other physicists, because Papin experimented with a vessel only two-thirds full, so that the water could expand freely, while a boiler tube is completely filled with water when it is heated, says the *Engineering and Mining Journal*. Inasmuch as the water expands far more rapidly than the tube, a pressure is set up on the inside of the latter, on the safety valve, and on the pressure gauge, the pressure exceeding that of an effective atmosphere long before the boiling point of water is attained. A tube of 25 mm. (1in.) inside diameter has a content of 0·00049 cubic metre per running metre; and if this tube be raised in temperature from 10 deg. to 80 deg. Cent., for instance, it will be elongated by 1·05 mm., its capacity becoming 0·0004905 cubic metre, while the water, which at 10 deg. Cent. occupied the above-named space of 0·00049 cubic metre, will at 80 deg. Cent. attain a volume of 0·000504 cubic metre, the capacity of the tube will have increased by 0·1 per cent., and the volume of the water by 2·87 per cent.

ACCORDING to returns compiled by Lloyd's Register at the end of the half-year, there were under construction in private yards 580 merchant vessels, of 1,322,068 tons gross, and 74 warships, of 220,610 tons displacement, or a total of 654 vessels, of 1,542,678 tons, as compared with 685 vessels of 1,436,245 tons at the end of the previous quarter, 514 vessels of 1,085,836 tons at the end of June last year, and 480 vessels of 970,677 tons in June, 1896. The present total constitutes a record in the tonnage under construction. The amount of merchant tonnage put into the water in the six months amounted to 395 vessels of 644,976 tons, against 334 vessels of 496,979 tons for the first six months of 1897; 330 vessels of 545,735 tons in 1896; and 266 vessels of 440,035 tons in 1895. Of the tonnage under construction 82·57 per cent. is for British owners, against 75·37 per cent. a year ago. About the same quantity of merchant tonnage is under construction abroad at the end of June as there was a year ago. Germany has building 42 vessels of 90,633 tons gross, against 39 vessels of 101,474 tons a year ago; France, 26 vessels of 68,836 tons, against 23 vessels of 52,209 tons; Italy, 14 vessels of 33,234 tons, against 11 vessels of 19,500 tons; the United States, 30 vessels of 25,805 tons, against 12 of 9500 tons; Holland, 20 vessels of 24,837 tons, against 20 vessels of 24,370 tons; Norway, 23 vessels of 19,170 tons, against 17 vessels of 14,698 tons; and Japan, 4 of 15,900 tons, against 7 of 12,337 tons a year ago

## MISCELLANEA.

A NEW harbour is to be made on the Southern shore of the Gulf of Finland, which will serve as an outer harbour to the commercial port of St. Petersburg.

ON Tuesday last the Standing Committee on Law of the House of Commons, sitting under the presidency of Sir James Fergusson, passed the London University Commission Bill, which was ordered to be reported, with amendments, to the House.

THE summer meeting of the Institution of Junior Engineers, of which Mr. John A. F. Aspinall—Lancashire and Yorkshire Railway—is President, is to be held at Liverpool, from 8th to 13th August. The President-elect is Sir William H. White, of the Admiralty.

THE authorities at Shanghai have authorised a native company to start waterworks on the European plan, to supply water to the city of Shanghai, and a fine bund or quay has been constructed at the Government expense, in continuation for some miles of the bund of the foreign and French settlements.

ACCORDING to an evening contemporary, a drainage scheme for Cairo has been submitted to the Ministry of Public Works by Mr. Willcocks, on behalf of the Cairo Water Company. The scheme is based on Sir Benjamin Baker's plans. The whole work will cost £E600,000, payable by the Government by yearly instalments of £E26,000, plus interest at the rate of 4 per cent. per annum. Besides the initial expense, the Government will, of course, require a large sum of money for the maintenance of the drainage, and it is therefore proposed to devote one-half of the revenue from the octroi towards meeting this heavy expenditure.

AT a congress of Russian mill-owners recently held at Moscow it was announced that the Government was on the point of subsidising steamers for the regular conveyance oversea of meat and other food products. The voyages would be weekly, and each boat would carry up to 300,000 poods of goods, including flour. It was resolved at the congress to petition the Government for a reduction of the export duty on flour by 40 per cent., and the announcement was made that an English company had offered to provide capital for the establishment of a Russian line of steamers between Baltic ports and Great Britain, of which the export of flour should be the special object.

THE lowest tender received by the Bridges Committee of the London County Council for the construction of a tunnel under the Thames to connect Greenwich and Millwall was that of Messrs. Mowlem and Co. for £119,732. Sir Alexander Binnie stated that he would be willing to construct the tunnel at his estimate of £83,175, provided the amount were made up to £100,000 to allow of the purchase of plant. The report of the Bridges Committee recommending the construction of the tunnel by the chief engineer of the Council without the intervention of a contractor was presented at the meeting of the Council held on Tuesday last, but, after a short discussion, was taken back.

A NEW process for the treatment of sewage, called the bacterio-thermal system, has been devised by Mr. P. S. Hyslop, M. Inst. C.E., by which it is claimed not only are the visible and noxious ingredients removed, but the disease germs themselves are effectually destroyed. The first effect, viz., the removal of the noxious putrescible matters, is produced by the action of bacteria; while the second, *i.e.*, the destruction of the disease germs, is due to the action of heat, hence the name bacterio-thermal. By this process it is claimed the ammonia contained in or evolved from the sewage during treatment is recovered as sulphate; while the effluent produced is not only clear, odourless, and germless, but is also incidentally softened.

IN his report on the trade of Shanghai, recently issued by the Foreign-office, Mr. Acting Consul-General Mansfield sounds a warning note to British passenger steamship lines running to the East. He says the various mail lines from Europe, notably the Messageries Maritimes, are in their new steamers making strenuous efforts to provide more and more luxurious accommodation for passengers. The latest vessels of the above company are models of artistic decoration, and of scientific provision for the comfort of those who travel by them. In these days the great mail liners have become floating hotels, and, as with hotels on *terra firma*, the travelling public will prefer those which provide the greatest amount of luxury and convenience at the least cost.

THE following amusing paragraph relating to the drainage of Cardiff appeared in a recent issue of the *Cardiff Western Mail*:—"Tradesmen in St. Mary-street, Cardiff, have lost a lot of time lately by standing on the edge of the pavement and expressing their appreciation of the borough engineer's new system of hydrostatics. The water tables are constructed on a parabolic plan that quietly invites the surface water to run up hill. As the water will not accept the invitation it stays still and stagnates, and the hydrogenated effluvia that march into the shops are so powerful that the tradesmen have to chain everything movable to the counters, whilst their endeavours to utter remarks appropriate to the occasion are positively distressing, and worse."

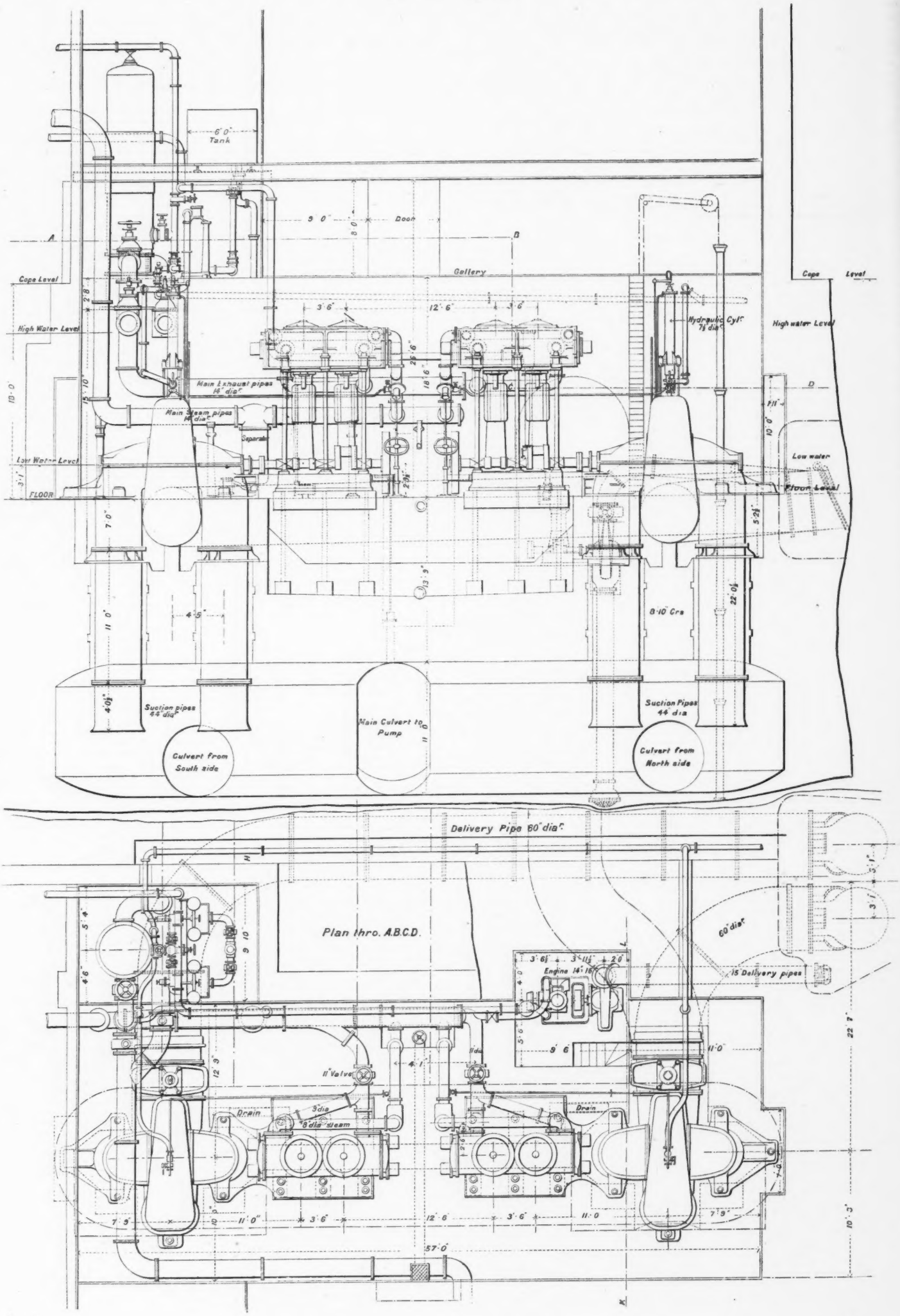
TO increase, if possible, the number of what may be called the staple products of Zanzibar, the Government has established an agricultural department under the superintendence of an English horticulturist, whose duties are not only to try to improve the methods by which the old-established crops are reared and harvested, but to introduce and cultivate experimentally any other plants which would be likely to thrive in a tropical soil, and which if successful would add to the commercial prosperity of the country. Experiments, which already give some promise of good results, have been made with cocoa, kola, vanilla, anatto, and several varieties of rubber, and trials are still being carried on with coffee, candle nut, eucalyptus, and other plants of economic value. Camphor, olives, safflower, and sarsaparilla are said to have failed.

REPLYING to a question by Sir C. Dilke, in the House of Commons on Tuesday last, with reference to the exaction of penalties from naval contractors, Mr. Macartney said the penalties were inserted in the contracts mainly for the purpose of ensuring that no preference was given to other work by contractors, and that due diligence was shown in carrying out the contracts. It was not intended that contractors should be mulcted in penalties for delay caused by circumstances beyond their control. Each case was considered on its merits, full explanations being demanded and considered in connection with the reports made by the Admiralty officers charged with the supervision of the work during its progress, and remissions were only made where circumstances sufficiently justified them. It would be undesirable to discontinue the penalty clause, and thus deprive the Admiralty of a power which, though rarely used, was a valuable protection against delay and breaches of contract.

HITHERTO the amount of machinery used and the progress made in labour-saving appliances, and modifying and reducing the cost of production in the stone branch of the building trade generally, is quite infinitesimal and insignificant compared with what has been done in other large industries. During the last two years a diamond circular saw has played an important part in the erection of the large new Post-office, Liverpool, from the designs of Mr. Henry Tanner, F.R.I.B.A., of her Majesty's Board of Works. It has been decided to put down, on hire, similar installations in various parts of the country, and to supply stone ready for fixing, and a company has been formed for this purpose. The blocks or slabs do not require any additional dressing after they leave the machine; waste of stone is reduced, and a saving in material effected; the blocks can be cut at any angle; only one man is required to work the machine, which may be driven by electric, steam, gas, oil, or water motor.

# PUMPING MACHINERY, GLASGOW GRAVING DOCK

(For description see page 78)

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